Mechanical World AND ENGINEERING RECORD

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BALL AND ROLLER BEARINGS BY HOFFMANN

THE HOFFMANN MANUFACTURING CO. LTD. CHELMSFORD, ESSEX

The METALASTIK family of COUPLINGS

The controlled resilience of rubber, when applied to couplings, absorbs shock loads and torsional vibration, and permits misalignment. The Metalastik family of couplings has been designed to meet special requirements and meets nearly every need.

The illustrations show the following :—

1, 2 & 3. **METALASTIK VEE-TYPE COUPLINGS:** a most successful type of coupling transmitting torque through rubber loaded in shear. Will absorb shocks and damp out vibrations, possesses high torsional flexibility, and accommodates shaft misalignment. The metal parts of Fig. 1 type can be bored and keyed for fitting directly on the shafts.

4 & 5. **METALASTIK ULTRA-DUTY BUSH COUPLINGS :** especially suitable for high-speed operation. The design permits a high degree of torsional flexibility and provides for shock loads, vibration and conical misalignment of the shafts. For greater flexibility and a larger degree of misalignment, these couplings can be used in series with a light shaft connecting two couplings, as Fig. 4.

6. **METALASTIK "ROTOFLEX" COUPLINGS:** provide considerable torsional flexibility, accommodate angular misalignment and a large extent of end float; they are particularly suited for cardan shaft assemblies. For high-speed operation a special centring device is used.

7. **METALASTIK UNIVERSAL COUPLINGS:** have considerable torque capacity and little torsional flexibility but will accommodate angular misalignment with very low resistance.

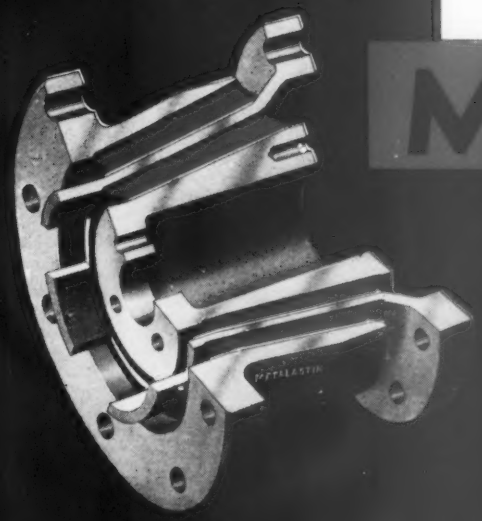
8. **METALASTIK DOUBLE-CONE COUPLINGS:** have a very high torque capacity and in other respects are similar to the Ultra-Duty bush coupling. End thrust can also be carried by these couplings and they are therefore particularly suitable for marine propulsion.

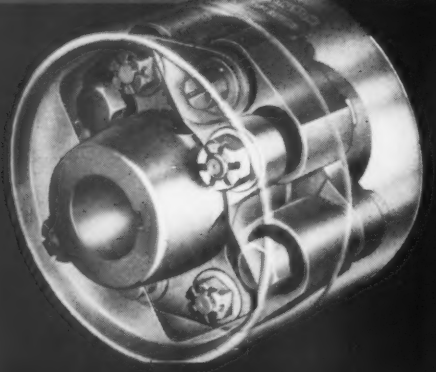
9. **METALASTIK TRAILING-LINK COUPLINGS:** accommodate considerable parallel misalignment as well as end-float and conical misalignment, and a single unit therefore replaces a long cardan shaft assembly.

The experience of our engineers is at the disposal of all who are interested in flexible couplings and full information of proposed applications should be forwarded to our Technical Department.

METALASTIK LTD., LEICESTER

METALASTIK





Mechanical World —— April 1959

Natural Economy

THE way in which motor car production has been maintained in recent months when so many other sections of metal working industry have suffered a marked diminution of activity is a mark of favour. While undoubtedly an engineering product and representative of a major division of transport, the motor car is also pre-eminently a private, or at least a personal unit, and in this respect very different from the railway train, the aeroplane or the steamship. It is a convenience of modern life, and like the washing machine, canned food or the T.V. set and other products has become essential to the many millions who engage in the routine of industry and commerce. The irreducible minimum is no longer anything like the contents of the emergency locker of a lifeboat: it is a complex of manufactured products at once made possible and dictated by the industrial way of life. The minimum volume of industrial output is not, therefore, the bare necessities of food, clothing and shelter, but the output of a whole range of industries which present these essentials in divided, diverse and processed forms, and which maintain not just the primary producers and the distributors but the processors also, and the latter are the more numerous. When there is a slackening of activity it is on the fringes, massive as they may be, of the industrial scheme, and in the less developed and therefore more vulnerable branches which are identifiable with particular parts of the world as well as with localities in particular countries. A slackening or shifting of interest in the industrial superstructure of armament production is capable, as we have seen, of diminishing the earnings and therefore the purchasing power of countries which depend upon the production of primary commodities, and this, in turn, reduces the demand for other things, which gets back ultimately to a wide range of engineering products, but not so much to motor cars, tinned peas, T.V. and the like. Thus the light sections of the steel industry remain active while some of the heavy sections close down. If the industrial world is so energized as to be thus nearly self-supporting, why cannot it be made entirely so? This question must often occur, but is it rightly posed? Observable phenomena of any kind are not of a static unchangeableness. The seasons by which the very food of life originates are an indication that activity is accompanied by cyclic change, and physical phenomena likewise show variation which is different only in degree. Why then should the results of human activity be constant? If experience is anything to go by it would be more profitable to live in a cyclic scheme of things than to suffer repeatedly by trying to go counter to half the cycle. Of course industry is not organized in this way. It is set for continuity. It either goes or it stops. This is understandable with some things. If you make aeroplanes, for instance, you cannot very well stock the product in the low part of the cycle for sale at the peak period—aeroplanes are not in the same category as fertilizers. With aeroplanes only design can be continuous; it seems that manufacture will always be discontinuous; and the same condition applies with many other things. Continuity is therefore applicable to the technological nucleus, but not to the technical majority of people employed. If this conclusion is true—and there seems no alternative—then it may be that what is wrong is the definition of skill. So many crafts are related to the product and not to the nature of the skill that when the demand for a product subsides there is a delusion that a lot of special skill has been rendered redundant. Anyone who knows what hands can do knows that this is not so. People would be more usefully known by what they can do, and not by labels attached to products. That, and the experience of the freshness and novelty that occasional changes of life could be made to offer might well be the answer to living naturally in the cyclic economy of dynamic civilization.

LOG SHEET

Laboratory Air Conditioning

Fully automatic air conditioning is a feature of the new laboratory recently constructed by the Ericsson Telephone Company Limited at Beeston, Nottingham. This laboratory, one of the most advanced telephone circuit laboratories in the country, has been designed to develop complicated electronic equipment in the overall exchange development.

The air conditioning, designed and installed by Norris Warming Company Limited, will maintain an even temperature, despite the emission of a great deal of random electrical heat. The building, covering some 44,000 sq ft, is divided into three floors—the top floor containing the offices of the directing staff, the first floor providing the development laboratory space, and the ground floor will be used for the manufacturing and assembly shops. The ground and first floors have a floor-to-ceiling height of 12 ft 8 in. to accommodate rack equipment. The building has a high fenestration ratio, and is provided with a latticed external building construction arrangement, which will have the same effect as sun blinds over the glazing, but will not restrict the amount of light entering the rooms.

Within the building, in addition to the normal occupant heat gains, electrical heat is emitted in two ways, firstly, through electronic equipment, lighting and other heat sources spread over the building, which will account for some 140 kW, and secondly through the test cabinets, of which there are seven, each emitting 20 kW. The air conditioning of the building has been based on maintaining an internal temperature of 10°F below the normal air temperature on hot summer days, with humidity conditioning. During the winter, the air supply system will provide all the necessary heat to maintain the building at a minimum of 65°F. In winter the air is heated by means of steam heater batteries, placed in the supply air duct.

The air conditioning plant consists of a main supply fan, drawing the fresh air in through filters, and discharging cooled, filtered and humidified air into the occupied spaces through air diffusers set in the ceilings. The vitiated air is passed through grilles into the corridors, and extracted via a main extract fan, and passed to atmosphere or recirculated through the main intake plant, as the atmospheric conditions warrant.

The local test cabinets previously mentioned are separately dealt with through a number of local supply fan and extract units, to avoid the concentrated heat emitted by these cabinets from upsetting the balance of the main air conditioning scheme. The cooling of the air is accomplished by means of spraying chilled water into the main stream. Water is obtained from deep artesian wells on the site, at 52°F, and is passed through a York Shipley 16-cylinder Freon 22 refrigeration cooler. This machine is one of the largest reciprocating packaged units in the country, and is driven by 170 hp direct-coupled electric motor.

The whole of the equipment is fully controlled, and is capable of operating summer and winter, completely automatically. The refrigeration plant operates as required, by hydraulic automatic valve gear, and the various motorised air supply dampers operate mechanically.

The building has been divided into five separate zones, each of which is individually electronically controlled from thermostats placed in the conditioned rooms, so that as the position of the sun or other heat sources varies during the day, the plant adjusts itself automatically.

Inert Gas Production

Fuel gases of all kinds can form explosive mixtures with air. The pipes, tanks, gas holders and process vessels used in the manufacture or handling of fuel gases need to be emptied from time to time. Before air can be let in, fuel gas must be removed. This needs a suitable inert purge gas. For example, after a catalytic refining process has been carried out for a time, the catalyst promoting the process needs cleaning. Before this can be done, fuel must be purged out of the plant. When the plant is again ready to be put on stream, the system must be purged with inert gas to ensure the removal of all traces of oxygen in each case, to avoid the possibility of explosion.

In connexion with needs of this kind, the Dryer and Gas Plant Division of Birlec Limited is at present engaged in designing an inert gas generator with a capacity of 200,000 cu ft per hr. In the design air mixed with propane is deliberately ignited within an enclosed cylinder, and the inert gases generated by the combustion are collected and employed in the purging process.

A laboratory test in progress on a new burner design. The heat released by this flame is of the order of 20,000,000 B.Th.U. per hr

Development work on inert gas generator design is at present being carried out by the company to establish the optimum sizes of burner for a wide range of generator capacities.

Measuring Fuel System Efficiency

It is often difficult to measure accurately the increased or decreased efficiency of engine fuel systems when minor modifications are made, and to get over this Leyland Motors Limited have installed a new electronic equipment which measures fuel consumption within 1%. The

equipment also reduces the number of people required on a test and thus releases operators for other research work.

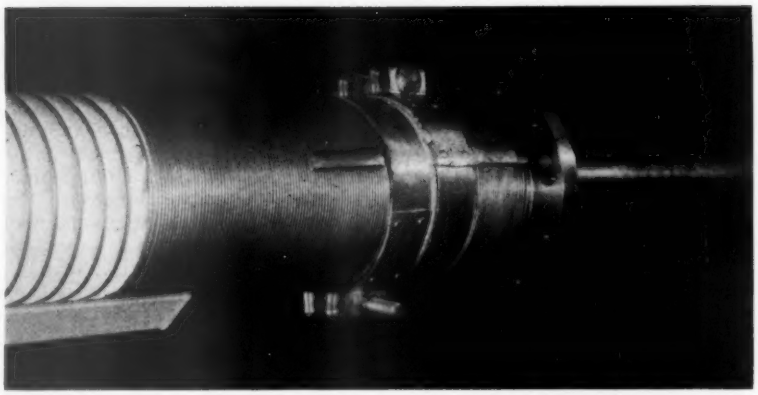
Developed by Farnell Instruments Limited, the electronic equipment incorporates a burette with two level marks and a series of photoelectric cells. When the fuel reaches the first level of the burette at the start of the test, the first photocell brings into circuit a time interval meter and a revolution counter, thus ensuring that the exact engine revolutions are counted and are not an assumed average. These continue operating until the fuel level reaches the second mark on the burette, when the second photocell automatically brings the test to an end.

To prevent unnecessary stops of the engine when fuel tests are carried out, the fuel consumption tester has been designed to allow the incoming fuel to fill the burette and to feed the engine under test at any time. When the fuel test is required, an electrically-operated valve in the fuel input line closes. Before the fuel has been completely run out of the burette the photocell operates and opens the incoming fuel supply line thus preventing any break in fuel supply to the engine.

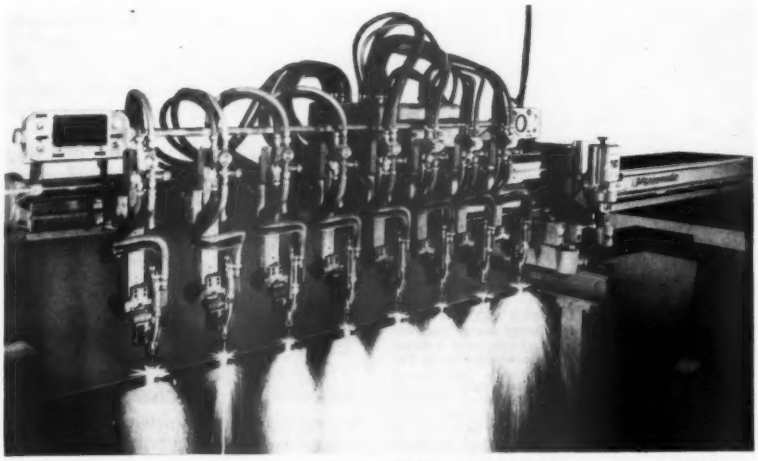
The time taken varies according to the speed of the engine and the size of burette used. With the models installed at the Leyland factories, fuel consumption tests average less than 60 seconds.

Supergrid Conductors

The largest conductors in the Supergrid will be on the Thames crossing at West Thurrock. They will be 2¼ in. dia.—aluminium wire on steel wire.



HOSE FOR LIQUID METHANE.—The Gas Council's trial shipment of liquid methane in the specially insulated tanks of the ship "Methane Pioneer", has to be discharged without raising the low temperature which keeps the methane from turning into gas. This 7 in. Compoflex flexible tubing and end fitting was specially designed and insulated for the purpose



EIGHT BURNER PROFILING MACHINE.—Believed to be the first of its type to be produced in the United Kingdom this eight-burner version of the Hancomatic oxygen profiling machine has been shipped by Hancock & Co. (Engineers) Limited of Croydon, to an overseas customer. Designed for the large-scale production of small shapes in sheet steel, the machine incorporates the recently introduced solenoid operated gas control valves for speedier operation. The new machine will be installed alongside another Hancomatic supplied about a year ago, a six burner model which has been in operation on day and night shifts almost continuously and at one stage two three-ton lorries were kept fully employed in serving it with small pressings which were mounted in a jig on the work table and cut six at a time

Walking Dragline

The walking dragline continues to develop for use in extensive excavations. One, costing £396,000, is at present being erected at the Yarborough ironstone quarry, Scunthorpe, of the Ore Mining Branch of The United Steel Companies Limited. This 790-ton machine, known as a W600, is expected to begin work in June. It has a 186 ft long jib and its 10 cu yd bucket will enable it to strip 15 tons of overburden at each bite. The iron ore thus uncovered will be removed by smaller mechanical diggers. Initially, the depth of overburden will be 30 ft, increasing as the quarry is exploited.

The W600 is the second machine of its kind in the Scunthorpe area, the previous one having been in operation at the Ore Mining Branch's Crosby Warren quarry for the past two years. Both quarries are engaged in supplying the adjacent works of Appleby-Frodingham Steel Company with iron ore. When the new dragline starts work, the Yarborough quarry will be able to provide between 36,000 to 40,000 tons of iron ore per week for the Appleby-Frodingham blast furnaces.

Dragline Assembly

At the Ipswich works of Ransomes & Rapier Limited, the makers of large draglines, a combination of a welded and bolted construction has made possible quick dismantling of the dragline and ease of transportation with comparatively easy re-erection on alternative sites. One of these machines carries a 7 cu yd bucket on a 140-ft boom or a 5 cu yd bucket on a 180-ft boom. It has a working weight of 380-tons and is capable of cutting to a depth of 125-ft. Under normal conditions with readily handled material, a cycle of dragging and hoisting the bucket, slewing through 90°, discharging and return should be completed in 50 seconds.

In the application of dragline equipment for mining of opencast coal, iron ore or clay, ease of dismantling, transfer and re-erection is a vital factor and a combination of welded and bolted construction has been found most suited to meet these requirements. Twelve major welding runs totalling 150 ft are necessary in assembling the main units of the dragline structure. Seven

major welded assemblies form the main base and superstructure elements, the whole being of unit construction.

The main base is welded in three parts on manipulators in the workshop, using appropriate Quasi-Arc electrodes, particularly Radian and Ferron (new type). While positional welding was avoided wherever possible, it was carried out when necessary with Quasi-Arc Vortic electrodes. Any tendency to distortion was avoided by bracing various sections prior to welding.

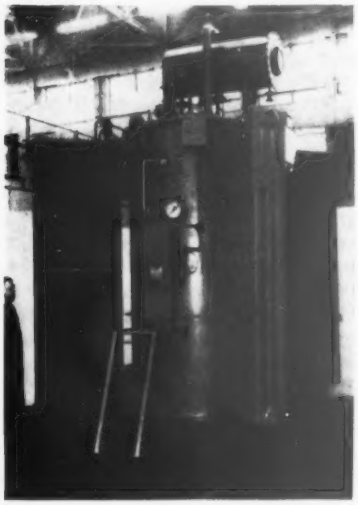
Each assembly is complete with the machinery, drive and other components ready for quick mechanical or electrical inter-connexion. Flame-cutting is used to dismantle the machine and is carried out along the welds. The spacing is designed so that other structural members are clear, necessitating only a minimum of 'making good' by welding.

The first of the new machines, which take their place in a range which includes the world's largest walking draglines, was supplied to Sir Lindsay Parkinson and Company Limited. It is being used on opencast coal mining at Heddon-on-the-Wall, Northumberland, and its erection on site occupied only six working weeks.

By-product Electricity

The generation of electric power is often considered in conjunction with steam raising for heating and processing. For example, it is often economic to produce steam at a higher pressure than required for a particular process, and then reduce the pressure through a back-pressure turbo-alternator set. As the demand for steam increases so more electrical energy may be produced, if desired, until there is a surplus which can be exported into the distribution system of the electricity authority. The amount of power exported may vary considerably from time to time, and, dependent upon the works demand for steam, it may occasionally be necessary to import power from the supply authority.

Electrically the arrangement is such that the local generator voltage is "tied" to that of the almost infinite capacity system and can only be varied independently at the expense of wattless current in the interconnector, which represents a reduced power factor.



Ferranti 10,000 kVA moving coil voltage regulator at United Steel, Workington

Local generation of electricity can also be an economical proposition where supplies of waste gas are available from blast furnaces and coke ovens. The accompanying illustration shows one of two 10,000 kVA 3-phase Ferranti moving coil voltage regulators recently installed by the United Steel Company Limited, Workington. The regulators have a 14% voltage range for use in twin lines 1½ miles long interconnecting the local works system with the 11 kV public electricity supply network and provide a method of controlling the import and export of electric power. The regulators enable the alternator voltage to be varied independently, and the current along the interconnector is maintained at an improved power factor. The improvement in power factor increases the permissible loading along the interconnector and will bring substantial financial savings dependent upon the terms of the tariff negotiated with the supply authority.

MOTOR FOR CONTINUOUS RUNNING.—This 250 hp, 3000 rpm, squirrel cage motor has been designed to run for a minimum of two years without shut-down. It is one of a large number supplied to the U.K. Atomic Energy Authority and has forced lubrication to the bearings from a pump driven through spherical bevel gearing. The machine has a degree of dynamic balance much above normal commercial standards. As shown here it was part of an exhibit at the I.E.E. exhibition typifying the work of Laurence Scott & Electromotors Limited in the field of special machines developed to meet specific requirements

OUTSIZE CONVEYOR BELT.—This is one of the biggest single lengths of conveyor belting ever built by the Goodyear Tyre & Rubber Company (Gt. Britain) Limited. It was made at the Wolverhampton plant in 32 oz cotton duck and is a 42 in. × 8-ply Goodyear Stacker belt, with a top cover of $\frac{1}{4}$ in. and a bottom cover of $\frac{3}{32}$ in. It is 1,350 ft long and weighs about 11 tons. The belt was ordered by Guest, Keen & Nettlefolds Limited of Eastmore Works, Cardiff for carrying iron ore.

Advice on Packaging

A technical committee which can assist industry in its packaging problems has been formed by the National Federation of Box and Packing Case Manufacturers. Both the Printing, Packaging and Allied Trades Research Association and the Timber Development Association are represented on this committee (the Research and Development Committee) which has been set up with the object of providing advice and information on all technical matters relating to the design and specification of timber and plywood cases and pallets.

PATRA's laboratories at Leatherhead are equipped to deal with most packaging problems and its testing department is said to be the most up-to-date in the country. In addition to carrying out research into such matters as journey hazards, the properties of cushioning materials and the cutting and creasing of carton board, it also maintains a biological laboratory which is

PERMANENT MAGNET MANUFACTURE.—Since the beginning of this year the permanent magnet business of English Steel Rolling Mills Corporation Limited is being carried on by English Steel Magnet Corporation Limited, North Street Works, Openshaw, Manchester, a new wholly owned subsidiary of the Parent Company, English Steel Corporation, Limited, Sheffield. The plant for the production of permanent magnets includes well equipped machining, heat treating and testing departments, and now concentrated under one roof. The pictures show the heat treatment and machine shops

concerned with problems connected with mould and insect attack on packaging materials. The association's information and advisory service is available to give details about machines, materials and sources of supply, and the monthly issues of *Packaging Abstracts* give summaries of articles about packaging developments which have appeared in the world's technical press.

The T.D.A., at its laboratories at Tylers Green, carries out research into the properties and treatment of hardwoods, softwoods and plywoods, including such questions as strength properties, resistance to decay and insect attack, methods of preservation, seasoning, etc. The T.D.A. staff, both in London and in the regions, can answer queries on the selection, use and supply of timber and plywood for cases and pallets of every kind. In addition, the association produces literature on many subjects, some of which relate to the question of packaging and the problems which it may involve.

Information is available from: the National Federation of Box & Packing Case Manufacturers, St. Giles' House, 50, Poland Street, London, W1.; the Printing, Packaging and Allied Trades Research Association, Patra House, Randalls Road, Leatherhead, Surrey; and the Timber Development Association, 21, College Hill, London, EC4, and its offices at Glasgow, Leeds, Manchester, Bristol, and Birmingham.

Cement Handling Plant

A new bulk cement handling plant at their Erith works is the latest addition to Turners Asbestos Cement Company Limited facilities.

The cement is delivered by barge, and the unloading plant consists of a counterbalanced bucket elevator suspended from an A-frame structure so that its height can be regulated to suit variations in tide and draught. This elevator discharges into a screw conveyor fixed at one end and arranged to move in conjunction with the movements of the bucket elevator at the other. Cement is then passed through a second fixed screw conveyor which delivers the cement to a surge hopper arranged over a Fuller Kinyon cement pump. This pump and ancillary equipment, as well as the main control desk and the plant required for supplying barges with power and compressed air, is housed in a building adjacent to the unloader structure, and is arranged to discharge cement through a pipeline made from T.A.C. asbestos cement pressure pipes and electrically-operated, remotely-controlled valves to the machine silos. The control desk is arranged on the graphic diagram principle so that the flow lines in use and the extent to which the silos are charged can be seen at a glance.

The barges in use have a maximum capacity of about 350 tons and the plant has been designed to handle this quantity into the storage silos well within one tide. The layout has been arranged to allow for the installation of a second unloading plant at a later date to enable two barges to discharge simultaneously.

Each of the four asbestos-cement making machines in the North Factory is arranged with its own 300-ton storage silo which gives sufficient reserve of cement to deal with delivery hold-ups due to unusual weather conditions. The silos are also arranged so that they can, if necessary, be filled from or discharged into road tankers. When required, the cement is automatically withdrawn from the base of the silos, conveyed to weighers, and batched into the process as required.

Moulding Compound

During the last five years a new plastics material known as Beetle D.M.C. dough moulding compound has been finding increasing use in the electrical and automative industries both in the United Kingdom and the United States, particularly for applications where good resistance to shock, high dimensional stability and good electrical properties are required.

The compound, which is made by British Industrial Plastics Limited, Tat Bank House, Tat Bank Road, Oldbury, Birmingham, consists essentially of an unsaturated polyester resin, inert fillers and glass reinforcing fibres mixed into the form of a fibrous dough.

It may be compression or transfer moulded when it is characterized by its easy flow and rapid cure; the resultant mouldings have high impact strength, good electrical properties and dimensional stability.

Several grades, including a self-extinguishing grade are available. Mouldings made in Beetle D.M.C. may be machined quite easily under normal conditions but it is important that all cutting tools and drills are tungsten carbide tipped owing to the abrasive nature of the material when cut.

Joining Thermoplastic Pipes

Unlike the original plastic pipes which were thermosetting and had to be fabricated by laboriously forming the plastic around a mandrel, the modern thermoplastic pipes can be mass produced by extrusion. The thermoplastic property also aids the pipe fitter, for a pipe can be bent to follow any direction required. This article reviews briefly the present day methods of joining and fitting these pipes

PLASTIC pipes were originally made from thermosetting resins and fillers, the fabricating technique involving the forming of the plastic around a steel rod or pipe, which served as a mandrel to be withdrawn when the forming operation was complete. This method of pipe manufacture is slow and laborious, and this is reflected in the price of the finished article. With the development of thermoplastic materials such as polyethylene, polystyrene and polyvinyl chloride, manufacturing costs have been greatly reduced, for pipes in these materials can be fabricated by extrusion. Thus plastic pipes are now amongst the mass-produced goods. Being thermoplastic, the pipes cannot be used for the conveyance of hot liquids or gases, for they commence to soften around 100°C, whereas the older thermosetting pipes could be employed at temperatures up to about 130°C. Apart from this limitation, however, thermoplastic pipes are quite as efficient as their thermosetting counterparts with regard to corrosion resistance, but the mechanical strength of the latter is generally higher than is the case with extruded products. Typical figures for thermoplastic pipes are tensile strength 6,500 psi; elongation at break 5%; flexural strength (ASTM D.790-49T) 9,000 psi.

Since the cost of thermoplastic pipes is sufficiently low to make them competitive with copper, lead or steel pipes, and they are freely available, they are being increasingly used in the food industries where the hazard of contamination is a factor, for handling corrosive liquids, and for cold water supplies. In the latter capacity many of the recent housing schemes incorporate them. The mining industry makes use of them underground for handling acidic mine waters, and in this application they have outstanding resistance to atmospheric, galvanic and chemical corrosion. In nearly all applications of the pipes it is necessary to make joints, either plastic to plastic or plastic to metal, and while these operations are not difficult they differ in some respects from conventional pipe-fitting practice. Joints come broadly into two classes, permanent and removable; welding being an example of the former, and bolted flange joints of the latter.

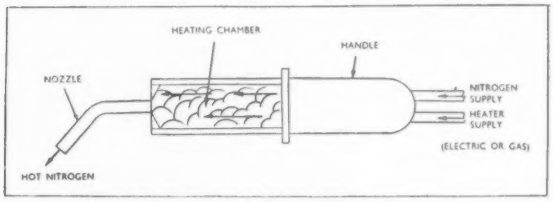
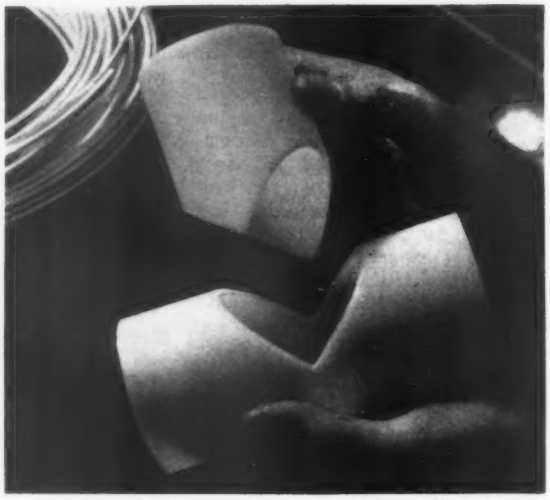


Fig. 1.—Hot-gas torch for the welding of thermoplastics



Monsanto Chemicals Limited

Fig. 2.—Two sections of Lustrex toughened polystyrene pipe showing method of forming a T-piece

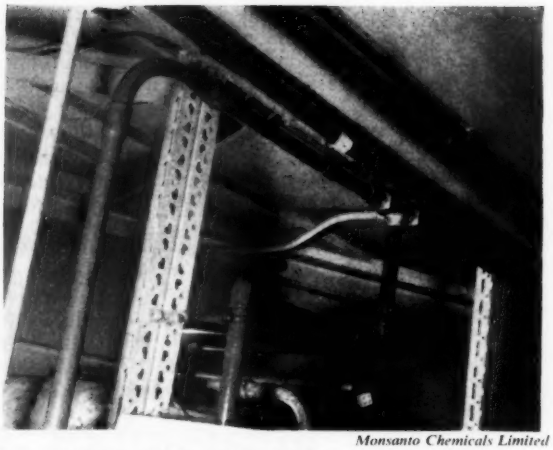
Welding

The welding of thermoplastics is not done by the aid of an arc or flame as in metal welding, for a temperature of under 300°C is sufficient, and this is attained by the use of hot gas. Hot gas welding provides a method of making a strong joint between two plastic pipes, or the forming of a T-piece for a branch line. The techniques of welding metals and plastics are similar in that two components such as sheet or pipe are brought into contact, and the two welded together by feeding in a filler rod. While in metal welding the object is to obtain a pool of molten metal in advance of the weld, in plastics welding the edges to be welded and the filler rod have only to be softened and the filler rod laid along the joint. Flux is not used. The hot gas may be compressed air or carbon dioxide, but an inert gas such as nitrogen is preferable, for this avoids oxidation of the welded joint and consequent weakening. A type of torch much in use is outlined in Fig. 1. This is fed with nitrogen gas from a cylinder which preferably has a pressure regulator to indicate the pressure and rate of flow. The nitrogen may be heated by gas or electricity. The filler rod may be a strip of the thermoplastic being welded; a short off-cut of pipe will make a number of strips of suitable size; the cutting being done with a coarse-toothed hacksaw having about 18 teeth per inch.

The items to be welded are cut and matched together to ensure a good fit, and a slight 45° chamfer taken from

Monsanto Chemicals Limited

Fig. 3.—Hot gas welding the T-piece. A rod of toughened polystyrene is held in one hand while a stream of hot gas is directed from a welding torch held in the other hand



Monsanto Chemicals Limited

Fig. 4.—Cold water pipe line constructed in Lustrex toughened polystyrene; the joints are spigot type

the fitting edges. If clamps are used for holding the two pieces, care has to be taken that the clamped portions are far enough away from the heat of welding to prevent softening and distortion while in the clamp. With the two pieces in position, the nitrogen supply is turned on and regulated to about 3 psi pressure. When the torch incorporates an electric heater, this is switched on a little time before the gas enters the torch; but a gas burner in the torch can be ignited at the same time as the nitrogen passes into the torch. A short period is then allowed for heating up the nitrogen jet, and the temperature of the latter is held at about 280°C, which is measured by a thermometer held within $\frac{1}{4}$ in. from the nozzle. With a gas-heated torch, the temperature is regulated by merely controlling the gas supply, while a small transformer can be used to adjust the electrical input to the heater. For thicker walled pipes, over $\frac{1}{8}$ in., the foregoing temperature may have to be raised slightly to maintain a reasonable welding speed. While the torch is held in the right hand, a strip of filler rod is held in the left at a point just above the commencement of the weld which is usually made in a direction from left to right. The hot gas jet is directed on to both the tip of the filler rod and the junctions of the parts being welded. When the strip has sufficiently softened, contact is made with the tip of the filler rod and a slight pressure applied to the rod in the direction of the line of weld so that the rod, which is kept at an angle of 25° to 30° to the vertical while welding, tends to bend over as welding proceeds.

A typical job is illustrated in Figs. 2 and 3, which depict the forming of a T-piece in Lustrex toughened polystyrene, showing the two prepared sections and the welding of the two together respectively. The softened rod welds the joint and is then fed on continuously by pressing the rod down lightly and at the same time moving the hand holding the rod in the direction of the line of weld. The jet of nitrogen is constantly playing on the filler rod and on the area next to be joined. When the end of the weld is reached, the surplus rod is left projecting from the welded joint and clipped off after the weld has cooled. Cooling of the joint may be accelerated by directing a stream of cold compressed air on the warm area. The strength of the welded joint is only a little below that of the parent material.

Spigot jointing

An easy method of joining two thermoplastic pipes together is by fabricating a spigot joint and then solvent-cementing or hot-gas welding the prepared joint. To form a spigot joint, a brass or aluminium mandrel having a diameter a few mils greater than the outside diameter of the pipe section is turned up. The small clearance is allowed so that in the final cementing of the joint, solvent is not expelled from the joint during assembly. The mandrel is heated to around 110°C, and simultaneously one of the pipes to be joined is also heated, either in a bath of boiling water (100°C) or in molten paraffin wax (120°C). A suitable bath consists of a one-foot length of steel pipe with an inside diameter at least one inch greater than the largest outside diameter of plastic pipe being handled. This pipe-length is closed at one end by a plug or welded plate, and three short legs are welded on to the closed end. The heated end of the plastic pipe is then pushed over the hot mandrel so as to form the female member of the spigot joint. Depth of penetration of the mandrel must not be less than twice the inside diameter of the plastic pipe. Pipe and mandrel are then chilled with cold air, and when cool the mandrel is withdrawn. The two components of the joint are checked for accuracy and any loose particles removed from the surfaces ready for cementing. The inside of the female spigot and the end of the male pipe are then brushed over with the cement or adhesive and the two portions pressed together. Examples of spigot joints formed in this way are seen in the cold water pipe line, Fig. 4. Cements which are in use for jointing plastic pipes include Britfix Cement and Armstrong Industrial Adhesives W400, 409, or 412. For working temperatures above 20°C the spigot joint is preferably hot-gas welded instead of cemented, for cements tend to creep at temperatures much over 20°C.

Threaded pipes

Sections of plastic pipe can be joined by threading, using conventional metal pipe fittings to connect the two threaded ends together, or similar fittings may be fabricated from a larger diameter plastic pipe. To support the inner bore of the pipe while a thread is being cut, a metal plug which has a sliding fit is used inside the pipe. A thread is then cut on the external pipe surface by means of a die and stock. Either a parallel or taper thread may be cut, but the latter is preferable. To prevent overheating the plastic a cutting oil, a soluble oil and water mixture, is used and swarf that this does not remove

is carefully brushed off. The threaded ends of the pipes may also be coupled to elbows or bends. Where an extensive pipe installation is involved, machined or injection moulded plastic components may be used in place of metal ones.

The thermoplastic pipes are more versatile than most metal ones in that they can be easily bent to follow a desired direction without the use of elbows. A pipe that has to be bent is first packed with dry silver sand and plugged at the ends with corks. It is then heated to its softening point in a water or wax bath until it can be bent as required. Bending may be done slowly by hand or by means of a hydraulic pipe bender, the dollies of which are heated. An alternative method of heating a pipe which is specially useful for pipes already fitted in an installation is by the use of an electric heating tape of appropriate loading so as not to get the pipe too hot. In every case of bending, the radius of the bend is not made less than six times the external diameter of the pipe.

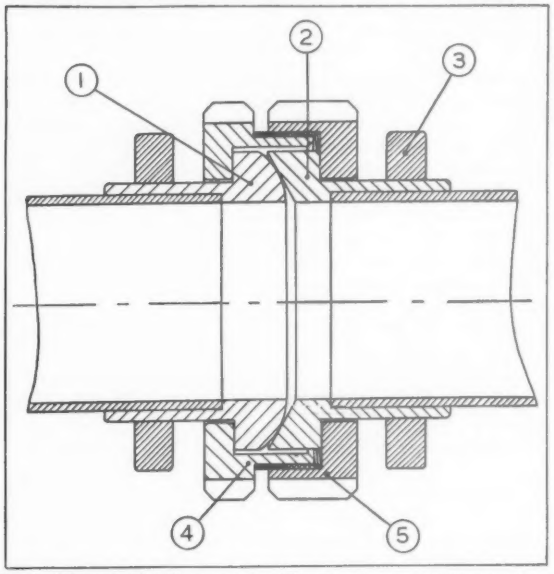


Fig. 5.—All-plastic joint. The parts 1, 2 and 3 are turned or moulded from toughened polystyrene; 4 and 5 are brass captive nuts for tightening up the joint

Flange joints

Amongst the various types of removable joint the flange pattern is probably the most simple to handle. The flanges on the pipe ends are made by turning up two brass or aluminium mandrels, and a brass or steel split collar and tapered ring. Pipe ends are trimmed square and the collar and tapered ring fitted on the end of the pipe, leaving a length of pipe at the free end protruding for a distance equal to the width of the required flange. The ends of the pipe are flanged by heating the mandrels and warming the pipe in a bath; the pipe is then pushed over the end of the mandrels in turn. One mandrel being employed to lead the flange in the right general direction, and the other one to make the final right-angled flange. A brass anti-friction washer with an outside diameter the same as the flange, and an inside diamater equal to the outside diamater of the pipe may be positioned in front of the split collar prior to forming the flange, so that when the joint is coupled the washer prevents the nut from gripping the rear surface of the flange. The junction is then made by assembling the two flanged ends of pipe sections, and joining with male and female brass captive nut. The fabrication of a return flange may be simplified by cementing or welding a turned or injection moulded plastic ring of the same material as the pipes, this ring having an internal diameter equal to the outside diameter of the pipe section. For pipe lines in which a certain amount of pressure will be present, a rubber sealing ring between the flanges improves the seal. This ring may take the form of a "top hat" pattern wherein the crown of the "hat" is retained inside the pipe on breaking the joint.

The design of the flange joint just described may be modified by bolting the two plastic flanged ends together as in conventional steel pipe practice; but flanges which have been formed over a mandrel cannot be satisfactorily bolted in this way. The outside diameter and depth of the flange has to be a little bigger so as to allow the drilling of bolt holes parallel to the axis of the pipe. Thus when this method of coupling the two flanges is to be used, the mandrels used in forming the plastic flanges have to be correspondingly bigger. The faces of the two flanges are then placed flush against each other and the two flanges coupled by either metal or plastic nuts and bolts. To protect the outside faces of the flanges, a metal facing washer is placed against each of the faces.

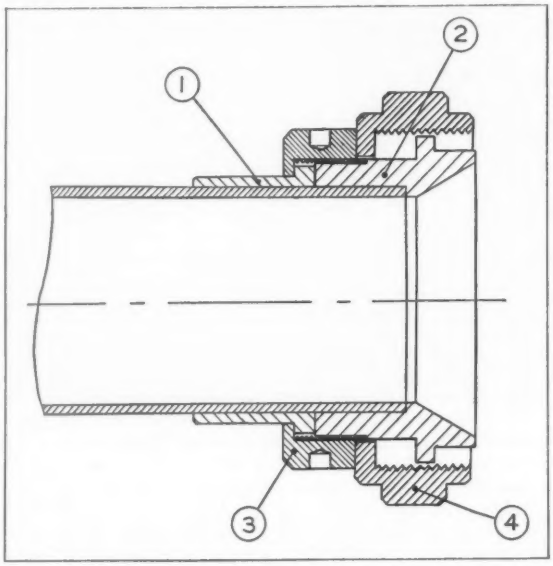


Fig. 6.—Female half of a coupling for joining toughened polystyrene to a metal pipe. The collar 1 is machined or moulded from the plastic; 2 is a brass coupling; 3 brass collar; 4 brass captive nut

Special joints

While the foregoing types of joint follow closely normal engineering practice, two special types of joint have been developed for joining plastic to plastic, and plastic to metal respectively. When the nature of the liquid being conveyed in the plastic pipe prohibits the use of any metal parts in contact with it, an all-plastic joint, Fig. 5, is generally suitable. The items 1 and 2 are turned or moulded from the same type of plastic as used for the pipes, and these items are cemented to the ends of the pipe sections to be joined. The collars 3 are also produced from the same plastic, and one each are cemented to the parts 1 and 2. The male and female brass captive

nuts 4 and 5 are then tightened to bring the parts 1 and 2 into intimate contact.

The method of joining plastic pipe to copper or steel pipe is outlined in Fig. 6, and this may also be applied to plastic/plastic pipes when required. The female assembly, outlined, consists of a collar 1 produced in plastic, a brass coupling 2, a brass collar 3 which screws over the brass coupling, locking against the back face of the plastic collar 1, and a brass captive nut 4 internally screwed and captive between the brass collar and the brass coupling. The male component consists of a brass nose machined to fit into the taper of the brass coupling, and threaded externally to receive the captive nut 4. This male component may be screwed, welded or brazed to the metal pipe to be joined. To cement the plastic collar 1 to the plastic pipe, a butyl acetate or other adhesive is used; the collar being positioned by using the brass coupling 2 as a guide and then removing it. Cold concentrated sulphuric acid is then applied to the protruding end of the plastic pipe and left for five min; the pipe is then washed and dried. The brass coupling 2 is next cemented to this acid-cleaned portion of the plastic pipe, and the cement or adhesive normally used consists of 65 parts by weight of Araldite 900 and 35 parts by weight of Polyamide 125; the two parts being assembled under slight pressure. These two adhesives are manufactured by Aero Research Limited. The brass collar 3 is then screwed on the bass coupling 2, thus clamping the brass coupling on to the plastic collar 1 and pipe. The excess adhesive is cleaned off the joint and the adhesive is allowed to cure for 48 hr at room temperature, or 6 hr at a maximum temperature of 60°C. To assemble the pipe joint, the captive nut 4 is screwed on to the male component fitted to the end of the metal pipe.

S.W.G.–B.G.–I.S.O. Partnership

The standard gauges are too well entrenched in current practice to be readily merged into one new system. For the present it appears that each will command its own field of usefulness

COMMITTEE MEE/-/7 of the British Standards Institution has reached some definite conclusions on the problem presented by the multiplicity of sizes for sheet strip and wire in current use ("Log Sheet", February, p. 55).

Too well-established to drop

Their first decision was that the S.W.G. is too well established a standard to supplant, so far as its use in Britain is concerned. The committee had to recognize, however, that there was no hope of getting the S.W.G. established as an international series under ISO auspices. The strongest possible attempt to do this was made at the first meeting of the relevant ISO committee in London in 1951, but was strongly resisted, largely because the Americans did not use the S.W.G. and would be most unlikely to accept it.

The committee then went on to consider whether they could contemplate the adoption in Britain of the range of thicknesses represented by the American preferred number series in inches. For this proposition there was support from the representatives of only one large firm; the rest of the committee felt unanimously that it would confuse matters in this country rather than the reverse. A proposal that the S.W.G. should be modified to bring it into line with the American series was also rejected as being impracticable. It was felt that there was no adequate reason at present to disturb the current use here of S.W.G. and B.G.

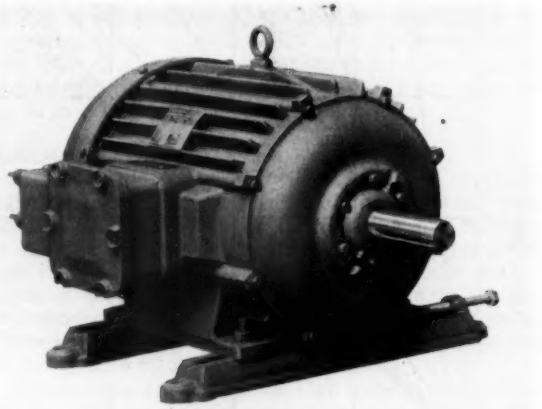
Metric sizes for international use

The committee then faced the proposition that if they could not support the American proposal there was little hope of securing agreement among the inch-using countries on an inch series of thicknesses for the ISO recommendation. The general feeling of the committee was that for international purposes the ISO metric series already agreed upon would be sufficient and that there would be no advantage in introducing a parallel inch series, and it was therefore agreed to inform the Australian Secretariat of committee ISO/TC 62 that the United Kingdom had now reached the conclusion that the present ISO recommendation should comprise the metric series alone.

In view of this recommended limitation, it was felt that much of the argument for a system of code designations in addition to the metric thicknesses was removed, particularly as the metric countries in the ISO committee had never shown any enthusiasm for a code or gauge designations. In this respect, the correspondence attracted by the previous publicity showed that British industry largely shared the Continental view on the matter.

The committee did feel, however, that due importance should be given to a provision in the present draft ISO proposal that the method of designating the thickness of sheet or diameter of wire should be by stating the basic size in millimetres, followed (if desired) by the letter "U" to indicate that this size belongs to the international metric series.

At an early date they intend to consider the domestic position with regard to the use of wire gauges. They would like to see published a British Standard giving full information both on the ISO metric series as well as the series of gauges at present in general use in this country, and giving some clear guidance that may lead to a greater concentration of United Kingdom usage on the S.W.G. and B.G.



FLAMEPROOF NON-FAN COOLED MOTOR.—Specially developed by Brook Motors Limited, Huddersfield for continuous operation in the presence of inflammable gases or dusts this cage motor is constructed to B.S.229-1957 for groups 1, 2 and 3 gases. The rating and performance is to B.S. 2613:1957 for all groups, also to B.S. 741-1937 for group one only. All casing joints are metal to metal; cartridge bearing housings are fitted as standard; when servicing the rotor can be completely removed without exposing bearings to dust; and endshield cavities are isolated from each other to avoid explosive pressure build-up

Spring Testing Machine with Deflexion Correction

The limitations of the fixed stop method of spring testing are discussed. A basic formula is evolved enabling corrections to be calculated and applied. The limitations of the formula are shown by an example. A new machine is described which enables fixed stop testing to be carried out without introducing any errors due to machine deflexion

By P. B. HINDE, Chief Designer, Testing Machine Division,
W. & T. Avery Limited

A WIDELY used type of spring testing machine employed for routine checking of springs is the self-indicating dial or fan type weighing machine fitted with a plunger for applying load to the spring under test.

Such machines are usually fitted with a deflexion scale which is attached to the weighing platform and so reads the true deflexion of the spring under test, automatically compensating for the movement of the platform. When testing large numbers of similar springs to a standard deflected length, taking a single load reading, it is much more convenient to depress the plunger to a dead stop and take the load reading. The stop is set so that the length of the spring is correct at the required load reading.

Limitations of current machines

This method of test, while very convenient, is subject to a serious limitation. Any springs which are not correct, and therefore show a high or low load reading, are not tested at the correct deflected length and therefore the machine reading of error is not the true one. The discrepancy is a function of the relative stiffness of the spring and the machine, using the term "stiffness" of the machine to mean the rate of platform movement in relation to applied load. The worst errors occur when testing a stiff spring on a soft machine (Fig. 1).

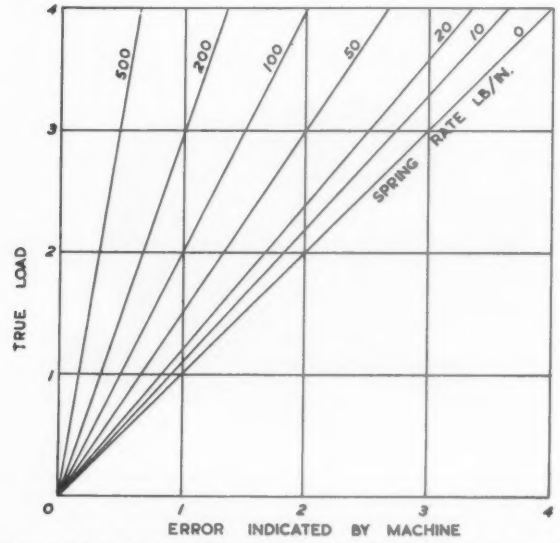


Fig. 1.—Effect of spring stiffness on error reading for machine having rate of 100 lb per in.

Fig. 2.—Spring testing machine

A new spring tester

In order to overcome this difficulty and to give a true reading of error, W. & T. Avery Limited, Soho Foundry, Birmingham 40, have introduced a modified form of machine illustrated in Fig. 2. This machine differs from the usual standard machine in three particulars:

(1) It is fitted with a precision depth stop with micrometer screw adjustment enabling accurate setting of deflected length of the spring being tested.

(2) The chart is graduated behind zero for about 10% of the chart range.

(3) A balance adjustment knob is provided to enable the zero reading of the load indicator to be adjusted externally.

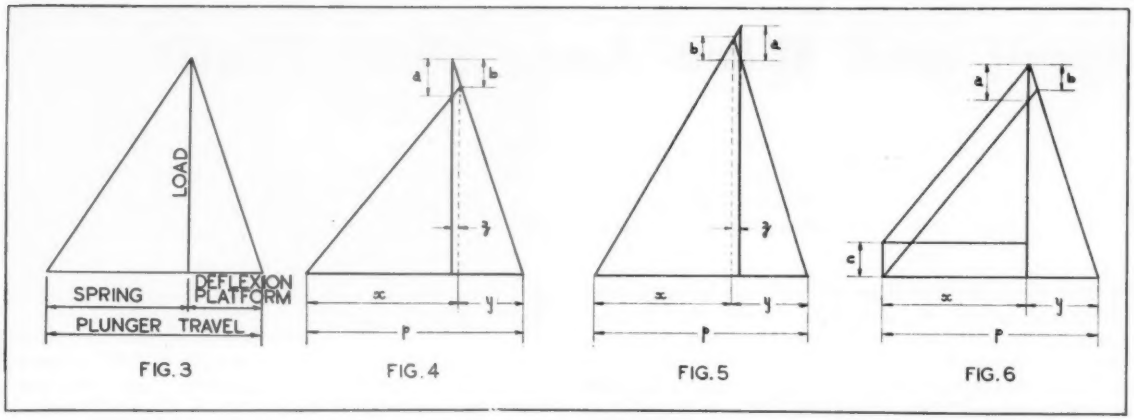


Fig. 3.—Correct spring. Fig. 4.—Weak spring. Fig. 5.—Strong spring. Fig. 6.—Weak spring on machine with balance adjustment

Method of operation

The machine operates thus:

(1) The load indicator is set to zero with the weight of the spring acting on the load platform.

(2) Using a length gauge, the depth stop is set to arrest the plunger at the required test load.

(3) Load is applied to the spring under test. If any error is shown then the balance adjustment is operated to bring the load indicator to the required test load, thus bringing the spring to the exact test length.

(4) The plunger is released. The load indicator will now read an error which is the true error of the spring being tested. If the pointer is behind zero the spring is too strong, if ahead of zero the spring is too weak.

It should be noted that it is not necessary to adjust to zero before testing another spring, the only adjustment needed is when the spring is loaded.

Behaviour of normal spring tester

The total movement of the plunger of a spring testing machine is made up of two components: the deflexion of the spring and the deflexion of the platform. This is shown in Fig. 3 where for convenience and clarity the datum has been taken as the platform surface, the other movements being shown relative to this datum. In Fig. 3 we have the desired conditions, for a correct spring. Fig. 4 shows the behaviour of a weak spring. For the true deflexion $(x-z)$ the load error is represented by a. The actual indicated error however is b which is always less than a because the actual deflexion is more than it should be by the amount z. Fig. 5 shows a strong spring to which the same argument applies.

Let s = stiffness of spring, lb/in.
t = stiffness of machine, lb/in.
w = applied load, lb
x = spring deflexion, in.
y = machine deflexion, in.
p = plunger movement, in.

then

$$x = w/s$$
$$y = w/t$$
$$p = x + y = w\,(1/s + 1/t)$$

from Fig. 4, a = true error, lb
b = observed error from machine, lb

then $b/x = a/p$

$$ax = b(x+y)$$
$$a = b + (by/x) \quad \ldots\ldots (1)$$

or $$a = b + (bs/t) \quad \ldots\ldots (2)$$

From this formula it will be seen that the observed error falls short of the true error by an amount equal to the ratio between spring stiffness and machine stiffness. As the machine stiffness approaches infinity then the second term disappears and $a = b$. Similarly, for a given machine stiffness the error decreases as the spring stiffness decreases (Fig. 1).

It should be noted that in formula (2) the stiffness s which has to be used is the actual figure for the spring being tested, and not the nominal value. In practice, for soft springs the difference is not significant, but for stiff springs an appreciable error could be introduced as illustrated by the following example:

Machine stiffness	100 lb/in.
Nominal spring stiffness	500 lb/in.
Actual spring stiffness	300 lb/in.
Load applied	50 lb.
Deflexion	0·1 in.

from formula (2)

$$a = b + (bs/t)$$

for $s = 500$ $\quad a = 6\,b$
for $s = 300$ $\quad a = 4\,b.$

For an applied load of 50 lb the observed error b will be 5 lb and if no correction is applied the spring rate would be 450 lb/in. Using the true rate of 300 lb/in. the corrected error = 20 lb which gives the spring rate at 300 lb/in. If it is assumed that the rate is 500 lb/in. and formula (2) is applied then the corrected error works out at 30 lb giving a spring rate of 200 lb/in.

Behaviour of the new machine

Consider the weak spring (Fig. 4). If we apply an external force to restore the load to its desired value we produce a condition as shown in Fig. 6. The spring is deflected by the true amount and the platform deflexion is as desired. The correction made under load is equal to a but the amount is not known until the load is removed and the resulting shift of zero is shown. This is represented on the diagram by c which is seen to be equal to a.

This value c appears on the load scale of the machine as a positive error for a weak spring and similarly as a negative error on a strong spring.

This method is not subject to any further errors when the spring rate differs widely from the nominal. As will be seen from the diagram the correction is related to the actual and not the nominal spring rate.

Steel and Wire Annealing Plant

The latest additions in a comprehensive programme of modernization to a notable steel plant relate to the heat treatment of wire and steel. Full instrumentation is employed and particular attention paid to light and ventilation, and to facilities for maintenance

TO enlarge their output of high grade electrically melted special steels, Kayser, Ellison & Company Limited, Sheffield have installed a new 800 ton press to increase output in their heavy cogging and forging section, a new three-high 14 in. mill to meet the shortage of lighter cogging and rolling facilities, a new 10½ in. double duo rolling mill to cope with the demand for smaller rolled sizes, and new centreless grinding and wire drawing machines. All this plant has been put in during the last few years and still the work of modernization continues.

In the latest developments six vertical pit type furnaces have been built in the wire department for annealing and normalizing drawn wire and wire rods over a temperature range of 600/850° C. Each furnace will take a charge of 2 ft 7 in. dia coils stacked 6 ft high on calorized mild steel spiders, and oxidation and decarburization can be reduced to a minimum by means of bells and sand seals. The furnace covers are at ground level with a hydraulically operated bogie and winch running over them for easy removal. These furnaces are fired by Town's gas using low pressure velocity burners, six per furnace with two-zone control. Two furnaces are fitted with complete programme control for use where the natural cooling rate of the furnace is deemed to be too rapid. Honeywell Brown automatic temperature control and recording equipment is fitted.

Charging a vertical pit type wire annealing furnace. The furnace covers are conveniently at floor level

A second and larger development concerns the new steel department's annealing plant and building which have been sited alongside the 10½ in. double duo rolling mill. Certain old buildings had to be demolished to clear the site for two new bays covering an area of approximately 8000 sq ft. Ultimately one bay will be extended to give a total floor space of over 13,000 sq ft. The foundations were constructed by M. J. Gleeson (Contractors) Limited, Sheffield, and the structural steelwork by Robert Frazer & Sons Limited, Hebburn-on-Tyne.

The aim has been to provide the best possible working conditions and great attention has been paid to adequate illumination. About half the roof area and some of the walling is glazed with Mellowes Georgian square reinforced cast wire glass ¼ in. thick in the form of fixed sashes in the roof and most of the gables.

Recurring maintenance of roof sheeting has been avoided by the use of Cellactite specially protected corrugated sheets; and the ventilators were fitted by Industrial Engineering Limited, London.

To facilitate cleaning the roof glass platforms are attached to heavy T-sections which form part of the glazing structure and which have extensions to accommodate the walkways, thus bolted brackets for the roof sheets—a common source of water leakage—are eliminated. Roof walkways and gutters are equipped with hand rails and stairways provide safe access to the roofs.

Ventilation and removal of fumes from the gas furnaces is effected by two 48 in. dia fan-assisted ventilators on the ridge of the roof, and, in addition, 36 in. fan-assisted ventilators are spaced equally over both roofs.

Artificial lighting is by Holophane high bay heavy duty industrial units arranged for use with 1000 watt Goliath Edison screw lamps; installation together with all the incidental wiring and switchgear, by the company's electrical staff.

The floor is mostly paved with 1½ in. thick cast iron plates, chiefly to a standard dimension of 3 ft × 4 ft, this being the most convenient size for handling when laying, but around the furnace is a 6 in. thick concrete

Car type annealing furnaces with control panels at rear. Each furnace has a capacity of 6 tons on a hearth of 17 ft × 4 ft

floor. The whole of the floorwork was done by M. J. Gleeson (Contractors) Limited.

The first bay is 30 ft wide and houses four Town's gas fired 6-ton car type furnaces of British Furnaces manufacture, with a hearth size of 17 ft×4 ft maximum capacity. The furnaces are constructed of hot face insulating bricks which are an important factor in giving low gas consumption and quicker heating cycles. Each has 20 low pressure velocity burners which feed gas and air correctly proportioned so as to maintain the desired atmosphere for steel heat treatment at all settings.

Furnaces control for temperature and internal pressure is by the Honeywell Brown Air-o-line system. Each furnace has five thermocouples along the roof, three of these being fed to a strip chart recorder and the other two to control instruments which regulate the gas and air input in accordance with a predetermined temperature cycle. An automatic damper in the outlet flue of each furnace maintains the internal pressure constant irrespective of the variation in fuel input. The instruments are sited close to the furnaces in a steel framed house, 20 ft×6 ft, illuminated by fluorescent lighting.

The second bay is 50 ft 6 in. wide and has a 10-ton overhead electric crane by Herbert Morris Limited, Loughborough. The cage is approximately in the centre of the crane to give the driver a good view of the loading platform and to relieve him of the heat and fumes from the furnace. A safety access stairway has been provided for this crane, in such a position that it also provides access to another Morris 10-ton crane operating in the rolling mill bay.

Owing to the restricted space available for lorries passing the corner of the building near the works gate, a cantilever design for the steel frame of the building has been adopted to enable the maximum amount of floor space to be covered by the overhead crane, whilst at the same time allowing lorries to pass underneath the cantilever portion. The loading platform and a Mather & Platt roller shutter have been installed across the cantilever corner of the building.

In addition to improving an already high standard of annealing, the installation of these new furnaces should materially assist the Clean Air Act by rendering obsolete certain older types of furnace. The completion of the two projects detailed above does not represent the conclusion of our modernization, and further operations are in hand at the moment.

Payment by Results

TO THE EDITOR OF MECHANICAL WORLD

Sir,—I have read W.G.F.T's comments in your December issue, on my article "Is Payment by Results Out of Date?" and feel I should make it clear that I don't rule out bonus systems as such, nor do I condemn work study which, after all, is just a fashionable way of saying "learning how many hours work are in a given job". I never hear or see the words "work study" without being reminded of the song "Getting To Know You" from "The King and I".

Incidentally, the stop watch is not the answer if the man holding the watch has not been through the mill and doesn't know all the tricks. Wily, smart guy operators can so easily throw dust in the eyes of the tenderfoot. I've known it done hundreds of times. Perhaps I should have stated in my article that I am concerned with medium to small plants engaged on general engineering production and maintenance work of almost endless variety. Our market is highly competitive and there is little time for frills. It should be remembered that such units employ many more people in the aggregate than do the glamorous giants engaged on million pounds contracts involving mass production. Obviously, more time must be spent fixing prices on such work because of its recurring nature, and it is a fact that practice makes for perfection. With long practice on one operation, a hastily conceived price would ultimately be shot to pieces. No such acute limitation attaches to general production where the odd bloomer may give rise to a storm of short duration but will have no cumulative effect because of the non-recurring nature of the operation concerned.

Concerning management in general, to which, incidentally, I belong, I do not suggest that all production executives require prodding, although a surprisingly large number do, and slick, experienced pieceworkers can be relied on to oblige if they feel that casual management is responsible for unimaginative planning and slender earnings. Furthermore, my conception of the ideal ratefixer is definitely not that of a superman—in a long industrial experience I can truthfully say I've never met one—"who by some infallible process always arrives at the right price for the job". My conception is that a speed-concious operator, of proved experience of the work in hand, or similar work, will more accurately and speedily arrive at the right price for a given job than will one lacking such first-hand experience.

C. Donald.

A.C. Traction

TO THE EDITOR OF MECHANICAL WORLD

Sir,—The article in Log Sheet of the February issue, "First A.C. Traction on British Railways", is inaccurate. Passenger trains were hauled by a.c. motors for some years on the old Brighton and South Coast Railway.

In fact it is questionable whether the change to d.c. when this line was amalgamated with other Southern Lines, was a wise one.

There was a lot to be said for the 6,600 volt single phase for long-distance work and the Wintern-Eichberg compensated repulsion motor was a simple sound machine.

The only original thing about the present electrification is the frequency of 50 cycles. All early traction systems were of lower frequency: the Brighton was $16\frac{2}{3}$ cycles.

Fairford, Glos. A. H. Smith

Steam Plant for Nuclear Power Stations

Concluding the comparison of principal design data on nuclear power stations in Great Britain

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., Consulting Engineer

(*Technical Adviser and Design Consultant to the U.K.A.E.A. 1950–1956*)

11. Auxiliary turbines for nuclear power station

These auxiliary steam turbines with their variable frequency alternators supply not only the electric power but provide speed variation for the a.c. induction motors driving the circulators. This speed variation is essential for it enables the quantity of gas coolant through the reactor to be varied to maintain a constant gas temperature at varying loads. Such auxiliary turbines have only been installed in the nuclear stations at Bradwell and Hinkley Point. Each has three sets, one being a spare. The maximum continuous rating of each auxiliary turbine at 3000 rpm is 20·5 MW for Bradwell and 33 MW for Hinkley Point. A significant feature of these turbines is that they operate on the conventional single-pressure steam cycle which simplifies considerably not only the design but the operation. The steam conditions at the turbine stop valve of the auxiliary turbogenerators correspond to those of the H.P. steam for the main turbines.

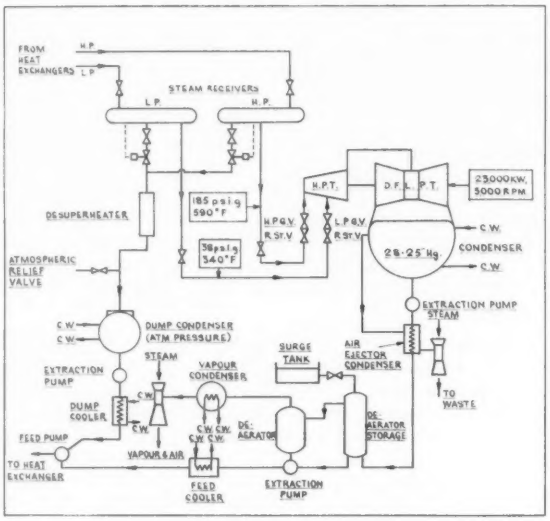


Fig. 9 (right).—Diagrammatic arrangement of steam plant at the nuclear power station, Calder Hall. Total number of sets 4; total rating 92,000 kW; rating per turbine 23,000 kW; H.P.G.V. high pressure governor valve operated by pressure transformer and speed governor oil pressure; L.P.G.V. low pressure governor valve; H.P.T high pressure turbine; D.F.L.P.T. double flow low pressure turbine; R.St.V. runaway stop valve

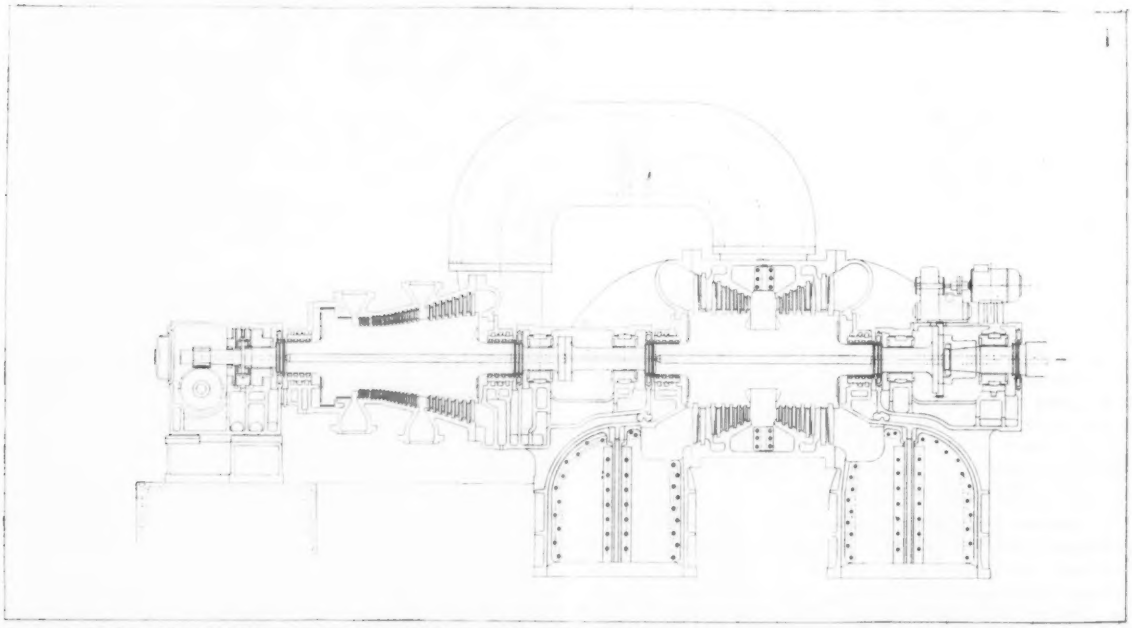


Fig. 10.—Section through 23 MW 3000 rpm turbine, Calder Hall. Steam conditions: H.P. 185 psig, temperature 590° F, quantity of steam 198,000 lb/hr 77% of total; L.P. 38·0 psig, temperature 340° F, quantity of steam 59,300 lb/hr 23% of total; vacuum at turbine exhaust 28·25 in. Hg. Number of stages: H.P. cylinder 22; L.P. cylinder (double flow) 2 × 6. Station thermal efficiency 21·5%

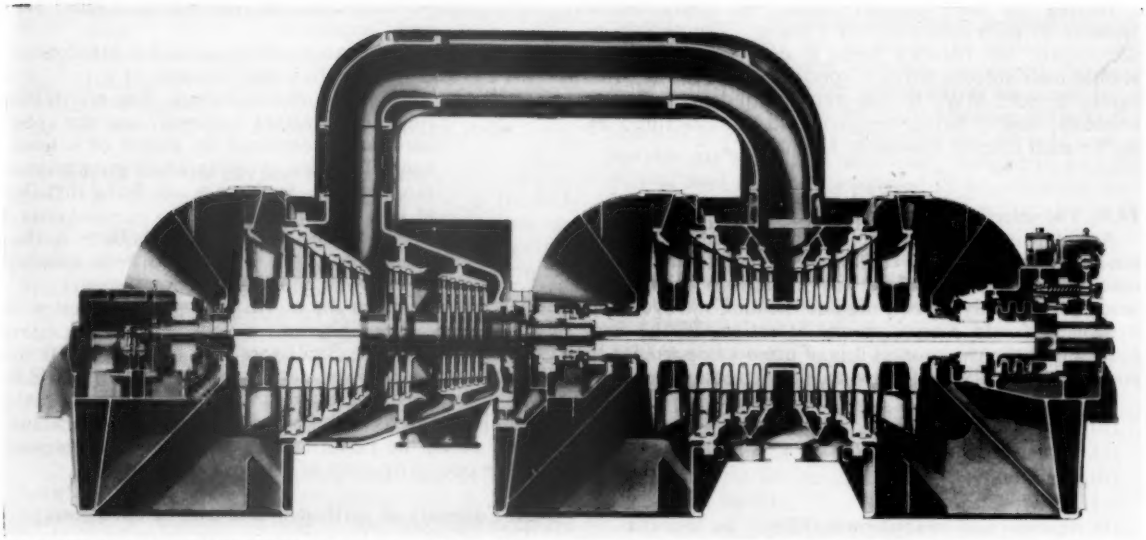


Fig. 11.—Longitudinal section of 80 MW 3000 rpm alternator at Berkeley. Steam conditions: H.P. 305 psig, temperature 610° F; L.P. 62 psig, temperature 610° F; vacuum 29·2 in. Hg. (30 in. Hg bar). Staging: H.P. 6 + 2 + (4 + II), L.P. 2 × (4 + II)

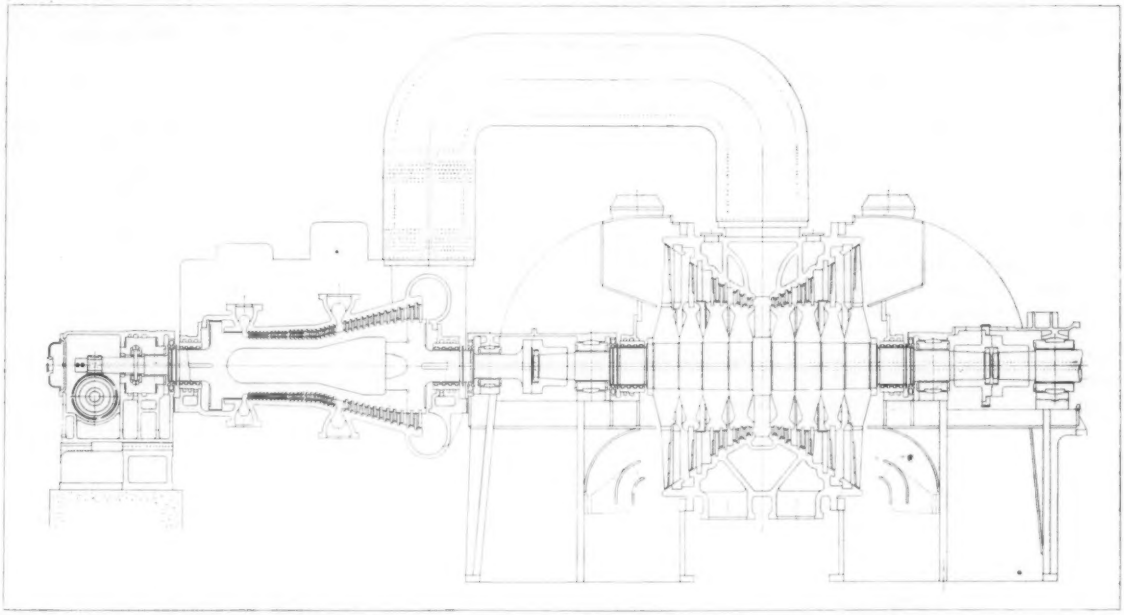


Fig. 12.—Sectional view of main turbine at Bradwell. Boilers: number per reactor 6, main shell dimensions 19 ft dia × 87 ft long, element construction Integron finned tube, H.P. steam temperature 373° C (704° F), H.P. steam pressure 770 psia, L.P. steam temperature 373° C (704° F), L.P. steam pressure 210 psia. Turbo-alternators: number and type 6 impulse reaction, maximum continuous rating 52 MW + 5% margin, speed 3000 rpm, generator voltage 11·8 kV, H.P. steam temperature at T.S.V. 371° C (700° F), H.P. steam pressure at T.S.V. 745 psia, L.P. steam temperature at T.S.V. 371° C (700° F), L.P. steam pressure at T.S.V. 195 psia

12. Diagrammatic arrangement of the steam plant for a nuclear power station

A typical example is indicated for the Calder Hall prototype in Fig. 9, which shows principally the water and steam circuits, the H.P. and L.P. steam receivers, the turbine with main condenser and its auxiliaries, surge tank, deaerator, desuperheater, dump condenser among other essential equipment.

13. Section through main turbines

The advance in design and the ratings of turbines for nuclear power stations, operating on the dual-pressure steam cycle, has been remarkable. This is clearly demonstrated by a section through the main turbine for the stations indicated below and shown in Figs. 10, 11, 12 and 13.

Station	Manufacturer	Number of sets	M.C. Rating MW (each)	Fig.
Calder Hall and Chapel Cross	C.A.P.	8 (Total)	23	10
Berkeley	M.V.	4	83	11
Bradwell	C.A.P.	6	52+5%	12
Hunterston	G.E.C.	6	60	13

Having the four together reveals the characteristic features of each manufacturer's design. The section of the turbine for Hinkley Point is not yet available: it should undoubtedly prove of special interest for its M.C. rating is 93·5 MW. It has three cylinders and four exhausts, and is being designed and manufactured by the English Electric Company Limited.

GAS CIRCULATORS

14.1. The selection of the gas coolant

An intensive investigation into the suitability of about ten well-known gases as coolants for graphite-moderated reactors, used for nuclear power stations in Britain, revealed that only carbon dioxide, helium, nitrogen and hydrogen should receive special attention. In the final selection of the gas coolant it is of utmost importance to consider primarily the following specific requirements:

(a) safety
(b) cost of the gas
(c) power consumption
(d) availability
(e) purity
(f) thermal and irradiation stability
(g) chemical compatibility
(h) neutron absorbing properties
(i) the degree to which the gas becomes radioactive
(j) heat transfer.

As the result of a closer examination of the properties of the selected gases it was decided that carbon dioxide offered the best compromise. For higher temperature reactors it might prove advantageous to use helium or nitrogen for they are inert. Although hydrogen is inert at ordinary temperatures it is chemically active at higher temperatures. An additional disadvantage is that it is highly inflammable.

14.2. Selection of drive for circulators

All the CO_2 gas circulators for the nuclear power stations in Britain are driven by electric motors, either d.c. or a.c. As it is imperative to vary the mass flow through the reactor with the load it is essential to have a variable speed drive for the circulators.

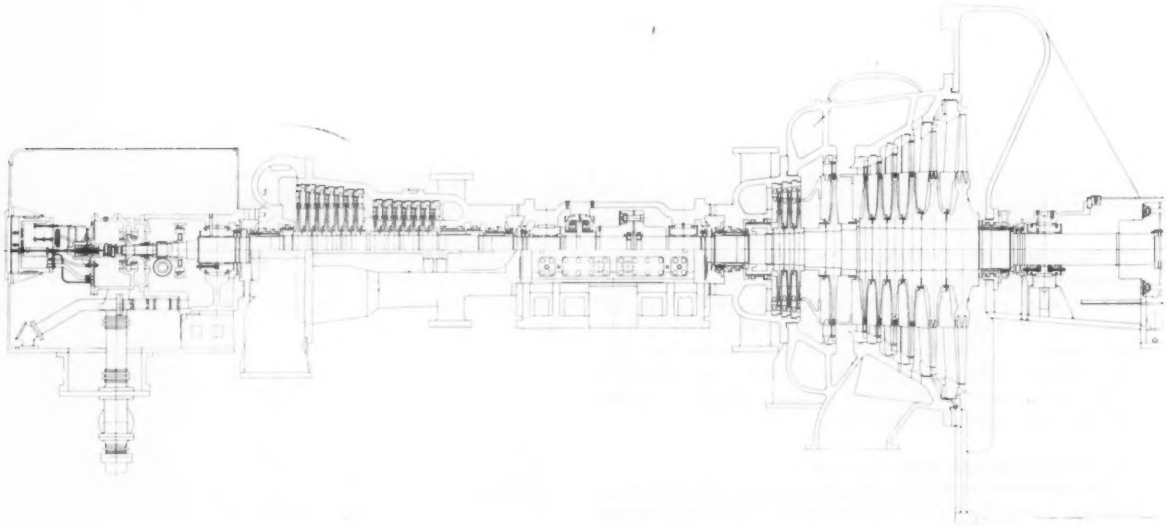
(a) For d.c. motors the supply is from:
  (1) A Ward-Leonard system as at Calder Hall and Chapelcross.
  (2) Mercury arc rectifiers as used at Hunterston.
(b) For a.c. motors the supply is from:
  (1) The main turbogenerators. The a.c. motor runs at a constant frequency and the speed variation is obtained by means of a scoop controlled fluid coupling which gives a speed range of 5:1. Such units are being installed at Berkeley.
  (2) The variable frequency auxiliary turbo-generators. This scheme has been adopted at Bradwell and Hinkley Point.

It is obvious from the above that since the design of Calder Hall, three alternative schemes for obtaining variable speed for the circulators have been applied to the first four nuclear power stations owned by the C.E.G.B. It would be most interesting and very instructive to have a detailed analysis with comparative data on the actual capital costs, the performance, the power consumption and the operating costs of these schemes.

14.3. Summary of particulars and data of circulators

This essential information is contained in Table XI which indicates:

(a) The gas pressure at the outlet from the circulator has increased from 100·3 psig for Calder Hall to 185 psig for Hinkley Point. This enables about 75% greater mass flow through the reactor.
(b) The pressure rise in the circulator varies from 5 to 7·5 psi.
(c) The maximum power input at the motor coupling of each circulator has increased from 2055 bhp for Calder Hall to 7000 bhp for Hinkley Point.
(d) The electrical power consumption for the circulators is about 10% of the generating capacity. This value applies particularly to Berkeley, Bradwell and Hinkley Point.
(e) The circulators are all single stage with an overhung impeller which was specially selected to reduce the gas leakage to a minimum.
(f) The circulators are usually arranged horizontal; however, those for Hunterston are vertical. The flow is either radial or axial. The maximum speed



is 1000 rpm for radial flow and 2900 rpm for axial flow.

(g) The speed control range is 5:1 for Berkeley, 10:1 for Hunterston and 4:1 for Hinkley Point.

(h) The diameter of the gas ducts is 4 ft 6 in. for Calder Hall and 6 ft 6 in. for Hinkley Point.

14.4. High pressure gas seal for circulators

It is of crucial importance to incorporate in the CO_2 circulator an effective and reliable high pressure gas seal to ensure that the gas leakage is reduced to a specified minimum. In addition the gland seal must be designed specially with a view to reliability, and accessability for replacement and maintenance. As a result of the recent remarkable advances in the operating pressures from 100 to 200 psi and probably at a later date to 270 psi, the designer is faced with a number of intricate problems. The success or failure of such gas seals depends primarily on the details, the technique and the precision of manufacture.

The selection of an overhung single stage impeller for both the radial and axial circulators has the desired advantage of eliminating one of the two high pressure shaft gland seals. Although a number of fairly advanced investigations are in progress on the design, the manufacture and the testing of such newly-developed seals, at the manufacturers' works, up to the present, very little information has been officially published. However, general particulars have appeared on the seals for the CO_2 circulators for Calder Hall. After careful consideration was given to various labyrinth and rubbing seals and suitable gas bearings it was finally decided to accept the oil seal used in hydrogen cooled turbogenerators, modified to suit the higher pressures and temperatures. This seal consists of:

(a) A floating ring with two U-type rubber packing rings located on a spherical seating in the bottom half of the circulator casing to which is bolted the keep.

(b) A loose collar keyed to the shaft and held by a nut. The floating ring is spring loaded against it.

(c) A rubber O-ring which seals the gap between the loose collar and the shaft. The collar has a nitrided face whereas the floating seal ring, which is $\frac{1}{8}$ in. eccentric to the axis of the shaft, is faced with white metal.

The seal oil is delivered to each circulator at 170 psig by two pumps, one driven by an a.c. and the other by a d.c. motor, which run continuously. This ensures a

Table XI.—A SUMMARY OF THE PARTICULARS AND THE DESIGN DATA OF THE CIRCULATORS

1	2	3	4	5	6	7	8
Item	Nuclear power station	Unit	Calder Hall A and B	Berkeley Gloucester	Bradwell Essex	Hunterston Ayrshire	Hinkley Point Somerset
1	Heat rating of each reactor	MW(H)	180	550	530	530	986
2	Total number of circulators		8	16	12	16	12
3	Number of circulators per reactor		4	8	6	8	6
4	Mass flow through each reactor	lb/sec	2000/2200	2900	—	—	—
5	Mass flow through each circulator	lb/sec	500/550	—	—	—	—
6	Inlet gas pressure at circulator	psig	94·77/93·61	—	—	143·0	180
7	Outlet gas pressure at circulator...	psig	100·3/100·3	125	130	150·5	185
8	Pressure rise in circulator	psig	5·53/6·69	—	—	7·5 max	5·0
9	Power input at motor coupling of each circulator	bhp	1542/2055	3000	4400	2190	5500/7000
10	Electrical power consumption per reactor ...	MW	—	17	20·5	12·6	33
11	Number of stages of circulator	—	1	1	1	1	1
12	Arrangement of shaft	—	horizontal	horizontal	horizontal	vertical	horizontal
13	Type of flow	—	radial	axial	axial	radial	—
14	Speed of circulator	rpm	854/940	2900	—	1000	—
15	Type of driving motor	—	D.C.	A.C.	A.C.	D.C.	A.C.
16	Scoop control fluid coupling for speed control	—	no	yes	no	no	no
17	Speed control by Ward Leonard system ...	—	yes	no	no	no	no
18	Speed control by mercury arc rectifiers ...	—	no	no	no	yes	no
19	Speed control by auxiliary steam turbines ...	—	no	no	yes	no	yes
20	Speed control range	—	—	5:1	—	10:1	4:1
21	Diameter of gas ducts	ft	4½	—	—	5	6½

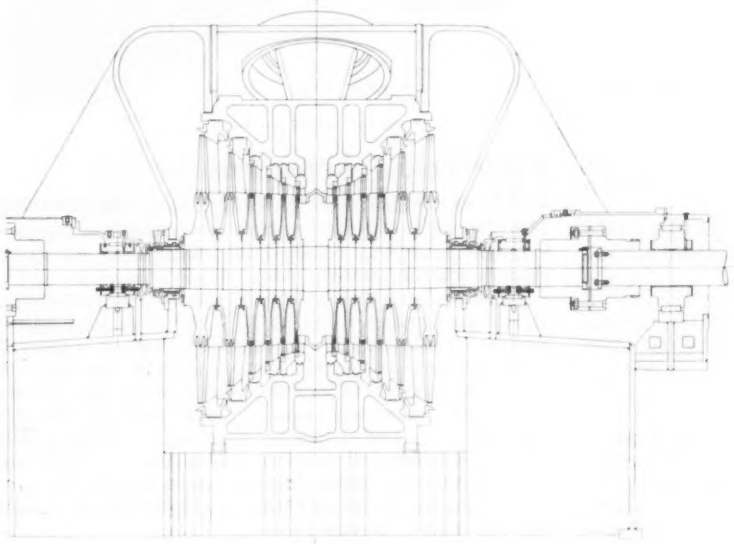


Fig. 13.—Sectional drawing of Hunterston 60 MW turbine

General Electric Company Limited

constant pressure in the oil system at all times throughout the full speed range of the circulator, i.e. 0 to 940 rpm.

14.5. Pony-motor drive for the circulators

As a standby source of power in the event of failure of the a.c. supply system, a separate pony-motor capable of driving the circulator at 100 rpm is mounted on the circulator pedestal and is coupled to the main driving shaft through a speed reduction gear consisting of three pairs of helical spur gears and synchro-self shifting clutch. The latter comes into operation when the speed drops to 100 rpm. This ensures that the circulator speed never falls below this in the event of a shut down. The above details apply to the circulators at Calder Hall. A d.c. pony-motor is also provided for slow speed emergency operation at Berkeley.

14.6. Motor generator set for Ward-Leonard system of speed control at Calder Hall

Each main d.c. motor driving a circulator is supplied with power from a motor-generator set which has a driving motor of the squirrel cage induction, direct-on starting type, rated at 2500 hp, 740 rpm, 50-cycle, 3-phase, 11,000 V supply.

15. Capital cost of nuclear power stations with graphite-moderated gas-cooled reactors

The approximate total capital cost for the complete station expressed in £ per kW of the net total generating capacity is indicated below in relation to the net total generating capacity.

Net total generating capacity of station MW(E)	£ per kW approx.
70	180
300	140
500	120
700	110

By 1962 the net total capacity installed in nuclear power stations in Britain will be 1596 MW. It is proposed to build a fifth nuclear power station at Trawsfynydd in North Wales. The sixth is to be located at Sizewell near Leiston, Suffolk, and the net capacity is expected to be 650 MW.

16. Advanced gas cooled reactor (A.G.R.)

The U.K.A.E.A. received permission towards the end of October, 1958, to build at Windscale an advanced gas-cooled reactor to be known as A.G.R. It is an experimental reactor for further development in the direction of much higher temperatures and fuel ratings. The main particulars, the performance and the design data are summarized in Table XII which shows the following significant features:

(a) Fissile material. Enriched UO_2
(b) Maximum temperature of the fuel element surface. 1112° F
(c) Outlet gas temperature at the reactor. 932/1067° F
(d) Mean reactor rating. 7·75 MW(H)/tonne
(e) Peak reactor rating. 18·0 MW(H)/tonne
(f) Maximum internal working pressure. 270 psig
(g) Gas coolant. CO_2

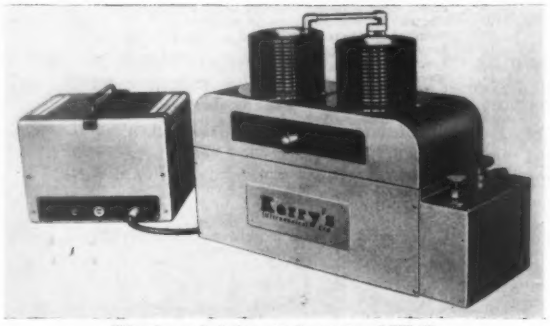
The total heat rating of the reactor is 100 MW and the 28 MW turbine at 3000 rpm is designed to operate on a single-pressure steam cycle for conditions at the turbine stop valve of 620/670 psig and 860° F. The dump condenser rating is 100 MW. The circulators are motor driven through a fluid coupling which gives a range in speed of 4:1. This scheme is in every respect superior to the other systems used in the nuclear power stations except Berkeley which fortunately is equipped with hydraulic couplings.

The experimental results obtained from this advanced gas-cooled reactor should prove invaluable, especially when considering further improvements in the design and performance of nuclear power stations.

Table XII.—PARTICULARS OF THE ADVANCED GAS COOLED REACTOR (A.G.R.)

1	2	3	4
1	Year of commissioning		1962
2	Total heat rating of the reactor	MW(H)	100
3	Total generating capacity	MW(E)	28
4	Number of reactors	—	1
5	Number of heat exchangers	—	4
6	Number of circulators	—	4
7	Number of main turbines	—	1
8	Rating of main turbine	MW(E)	28
9	Fissile material	—	UO_2
10	Initial enrichment (approx)	—	1·65 Co
11	Weight of fissile material	ton	14·6
12	Number of fuel channels	—	250
13	Number of control rods	—	25
14	Nominal core diameter	ft in.	15 ft 0 in
15	Nominal core height	—	14 ft 0 in.
16	Total weight of graphite moderator	ton	200
17	Maximum temperature of fuel element	°F	1112
18	Inlet gas temperature at reactor	°F	482/617
19	Outlet gas temperature at reactor	°F	932/1067
20	Gas temperature rise in reactor	°F	450/450
21	Mean reactor rating	MW(H)/tonne	7·75
22	Peak reactor rating	MW(H)/tonne	18·0
23	Shape of pressure vessel	—	cylinder
24	Diameter of pressure vessel	ft in.	21 ft 0 in.
25	Overall height of pressure vessel	ft in.	60 ft 0 in.
26	Maximum internal working pressure	psig	270
27	Thickness of material of pressure vessel	in.	3
28	Power input at motor coupling of circulator	— bhp	1200
29	Total power input to the four circulators	bhp	4800
30	Speed control range	—	4:1
31	H.P. steam pressure at T.St.V	psig	620/670
32	H.P. steam temperature at T.St.V	°F	860

The gas coolant is CO_2

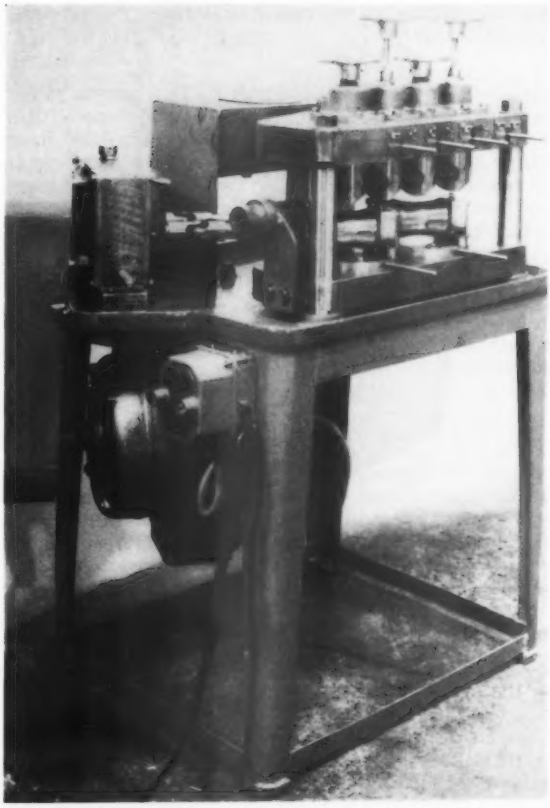


Filtration and rinsing attachment type LFU 60

Filtration Attachment for Ultrasonic Cleaning Equipment

This filtration and rinsing unit is specifically designed for the continuous removal of solids in liquid down to one micron particle size.

Made by Kerry's (Ultrasonics) Limited, Warton Road, Stratford, London E15, the LFU 60 filter unit passes the cleaning liquid by end filtration through a packed paper element or ceramic element suitable for use with either chlorinated or aqueous based solutions, respectively. The filtration rate is approximately 60 gph through a ¼ gall capacity cleaning container. The rinsing and filtration head can be swivelled either into the left- or right-hand cleaning container on the two-stage ultrasonic cleaning bath so as to obtain continuous fine filtration of cleaning liquids.



Bronx multi-roll tube straightening machine for high carbon steel hollow rocker shafts

Straightening Hollow Shafts

Specially designed for the motor car industry for straightening hollow rocker shafts, this multi-roll tube straightening machine was built by Bronx Engineering Company Limited, Lye, Worcs.

The rocker shafts of high carbon weldless steel tube ranging from 0·6680 in. up to 0·8736 in. dia in lengths from 14½ in. upwards are first normalized and then passed through the machine prior to machining operations. After being fully machined they are again passed through the straightening machine ready for the final operation of centreless grinding.

A typical example is quoted; prior to the straightening operation before centreless grinding the shafts were running out from 0·025 to 0·36 in. After one pass through the straightening machine, at 100 fpm the bow was reduced to 0·0015 in. for shafts up to 14½ in. in length and 0·0035 in. for shafts up to 20 in.

The machine is equipped with two lower driven rolls and four upper idle rolls, the lower rolls being driven through universal couplings from a common gear box by a single 6 hp 960 rpm squirrel cage motor, controlled by a direct-on-line push button non-reversing starter. All the rolls are of alloy steel fully heat treated for wear and mounted in needle bearings. The lower driven rolls are adjusted angularly and the top idle rolls have angular and vertical adjustment.

A drip feed paraffin tank is included to enable the roll surfaces to be kept clean and to assist in gripping the rocker shafts during straightening.

Jointless Flooring for Vehicles

A method of producing an inexpensive and durable jointless floor covering for commercial vehicles has been perfected by Tom Byatt (Engineers) Limited of Fenton, Stoke-on-Trent. Based on polyester resin made by Bakelite Limited, the new flooring surface is designed to protect the original floor against injury and will successfully withstand the damaging effects of heavy and abrasive materials such as coal, coke and granite.

The method is to score the original floor of the vehicle to provide a suitable key—a layer of Bakelite polyester resin suitably modified with an abrasive grit then being spread in a continuous film over the surface. A 2 oz. glass/fibre mat impregnated with a similar mix is then fixed into position over this first coat and the operation completed by the application of a final layer of the same resin containing a high proportion of the abrasive grit. The covering is then consolidated by rolling and allowed to set.

With the exception of hot ashes, any load can be accommodated on the Byatt flooring and being waterproof, is particularly valuable for carrying wet loads. Repairs, where necessary, are easily effected merely by building up the damaged section.

With no loose edges to impede free passage of contents, the new floor has proved particularly effective on all types of tipping vehicles and the weight of an average 6 ton LWB reinforced resin lining is only 36 lb compared with that of 1½ cwt of conventional steel floor lining.

Divining Instrument

An unusual and accurate method of detecting underground mains, sewers, disused or covered wells, buried manhole covers, voids and all types of mineral deposits has been invented and patented by Mr. L. J. Veale of Newton Abbot, Devon. The instrument used for the work consists of two cylindrical handles of chromium steel, each with a 21 in. indicator rod pivoted in it at right angles. Normally, the indicator rods held in the horizontal position remain parallel, but when the operator moves over any mineral or service, the rods swing inwards across each other pinpointing the object. The rods are delicately balanced on a system of needles and springs in the handles. The instrument, known as the Revealer, has already been used on surveys for local authorities and public works contractors by J. C. Oliver (Leeds) Limited, 7 East Parade, Leeds 1, who also claims success with the instrument for locating gold, lead, uranium and tin.

The principle of operation is that vibrations given off by the object being sought are transmitted to the detector. It will give a depth reading up to 205 ft, the diameter of pipes, and location of minerals regardless of the surface composition. By holding mineral in the hand against the apparatus, the nature of the mineral or service is determined, i.e., iron, asbestos, copper, etc. It will also clearly show which service is crossing over or under the other. It is non-electrical and totally eliminates the need for trial search holes before excavation.

Mr. Veale is represented by the above company and a service is in operation to consultants, local authorities and contractors on a fee paying basis, with unconditional guarantee to supply full details of the inspected area or site.

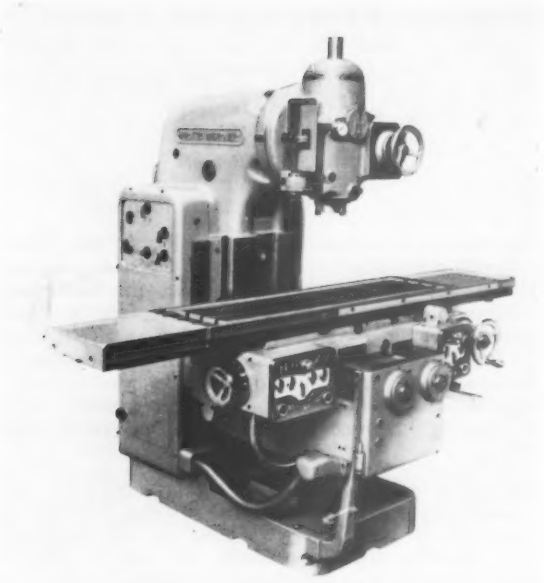


Fig. 1.—Werner electrically-controlled standard vertical milling machine, Type FV2D with a 53 × 14 in. (1350 × 355 mm) table

Fig. 2.—One of the standard horizontal machines of the new range, the type FH3D with a 63 × 17 in. (1660 × 431 mm) table

Finger-tip Controls Supersede Handwheels on the Werner Milling Machines

A NEW departure from the conventional control systems employed on milling machines was demonstrated last month at the London showrooms of The Rockwell Machine Tool Company Limited, Welsh Harp, Edgeware Road, London, NW2. The machines which constitute a new range of vertical, horizontal and universal types, are built by Fritz Werner of Berlin, and introduce an electro-magnetic control system of all movements by finger-tip rotary switches and push buttons which results in almost complete absence of handwheels and levers. Other prominent features of the machines include automatic clamping of the slides when at rest, instantaneous selection of feeds while cutting, rapid traverse in all directions on all standard machines and on the larger sizes 21 spindle speeds can be hydraulically selected. Optional features include duplication of operating controls at the rear of the machine; automatic vertical and transverse cutter relief; automatic backlash elimination and automatic indexing attachments.

A fully representative selection of the machines will also be exhibited this month at the company's Birmingham showrooms at 1-5 Cateswell Road, Hall Green, Birmingham 28, from April 7 to 17.

The standard range includes automatic and semi-automatic machines of vertical and horizontal types and table sizes for automatic machines are from 53 × 14 in. up to 91 × 20 in. for both types. There is also a new range of production milling machines comprising automatic and semi-automatic of vertical and horizontal types; table sizes range from 28 × 9 in. up to 49 × 14 in. Finally there are four new universal milling machines with a table size range from 53 × 12 up to 71 × 14 in.

One of the new Werner standard vertical milling machines, the Type FV2D, is shown in Fig. 1. Controls for the longitudinal, transverse and vertical table movements and for table feeds and cutter speeds are arranged in panels on either side of the knee, the operating panel on the left with finger-tip switches for feeds and rapid traverses for setting up and inching and the feed selector handwheel is shown in Fig. 3. In the standard horizontal machine Type FH3D shown in Fig. 2 an additional control panel is provided at the back of the table to enable the machine to be controlled from the rear. The cycle control panel on the left-hand side of the column in Figs. 1 and 2 is shown in Fig. 4 and is representative of the pattern fitted to the whole range. Using the selector switches A and B, normal milling cycles with or without skip feed, to-and-fro movement, automatic dividing, etc., can be set up to function automatically with any of 16 automatic table cycles available. Small table stops, which are easily adjustable, actuate limit switches in the control box through a rocker

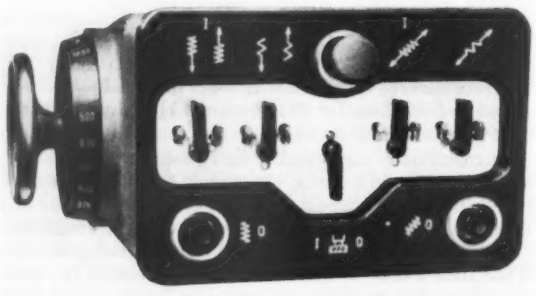


Fig. 3.—View of the operating panel fitted to the left hand side of the knee with directional finger-tip switches for feeds and rapid traverses for setting up and inching. With the exception of the centre lower switch which starts the cutter spindle, all others are fitted with safety latches to prevent accidental operation. Note the line diagrams used to describe the motions, close-pitch zig-zag lines indicating feed and wide-pitched zig-zag lines the rapid traverse. The hand wheel is for feed selecting

lever when the machine works on automatic cycle and thus initiate or stop the various movements in the desired sequence.

For setting up or one-off production, all functions can be controlled by directional fingertip switches and push buttons and the well planned arrangement of safety interlocks prevent accidents. For instance, neither rapid traverse nor power feed for the knee movement can be engaged accidentally when the handle has been inserted for manual adjustment. Another safety feature cuts out power feeds if the selected spindle were to stop, and prevents the engagement while spindle is stationary. The milling spindle drive has an overload clutch. Safety latches for locking those directional fingertip controls which are not in use prevent accidental engagement of the wrong switches or movement in the wrong direction. Fixed safety stops are furnished in addition to the easily adjustable traverse stops on all table movements.

The functioning of all the machining sequences is dependent on the electro-magnetic multiple disc clutches employed in the new range. Fig. 5 shows the feed drive unit with multiple disc clutches. The unit in the form of a cylinder is a completely self-contained assembly and with the exception of the brushes supplying the current requires no maintenance or readjustment during long service. Solenoids control the movement of machine parts and also the hydraulics. The electrical panels are mounted on a swing-out assembly frame to facilitate

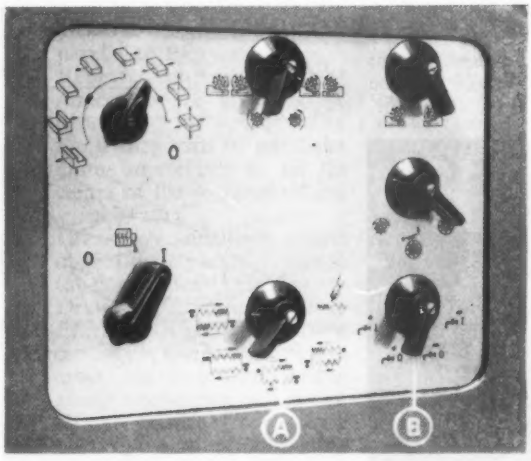


Fig. 4.—Switch control panel mounted on the left-hand side of the column for setting up 16 automatic table cycles. Automatic cutter relief for pendulum milling is controlled by the top left-hand switch. Switches A and B control the automatic work table cycles

inspection and maintenance. The switch-gear compartment is sealed with a dust proof cover.

The variation at the point of automatic changeover from rapid traverse to feed is under ·040 in. permitting the workpiece to be brought in rapid traverse practically right up to the cutter before the feed is engaged. All standard horizontal and vertical machines have hydraulic slide way clamping by solenoid valves for all three directions and on the universal machines hydraulic clamping for the cross and vertical movement only. Whenever the rapid traverse or feed is engaged manually or automatically the corresponding clamp is first automatically released before the movement begins and at

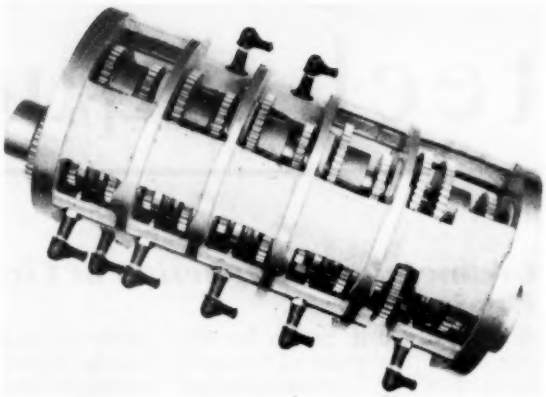


Fig. 5.—Completely self contained, this cylindrically shaped feed gear unit has eight built-in electro-magnetic multi-disc clutches for 24 feeds in a 1 : 200 overall ratio

the end of the stroke again comes automatically into operation. All slides not actually in motion are therefore locked. The clamping is unaffected whether machine power is on or off.

An optional feature is available in the form of automatic vertical and transverse cutter relief to prevent scoring by the cutter on the return stroke, particularly when using carbide tipped cutters. These cutter relief movements of approximately ·040 in. take place after completed feed and before automatic return starts. The hydraulic slide way clamping system works in conjunction with the cutter relief mechanism and after completed rapid return the table is guaranteed to come back to its working position within 0·0004 in. The amount of relief can be increased to 0·400 in. if several workpieces are to be loaded in a row on the table. Finish machined components can then be exchanged for unmachined parts as soon as they have passed the cutter. Automatic backlash eliminator can also be supplied for climb milling, a solenoid releasing the tension of the screw and nuts during the rapid traverse movements to prevent undue wear.

The spindle is fitted with an electro-magnetic brake which is interlocked with the feed so that it cannot be engaged while the spindle is stationary, and if the brake is applied when the spindle is running, the feed is cut off. For automatic work cycles an alternative setting is provided for the spindle to be either braked or to be free during rapid return.

All the electrically controlled horizontal and universal models are provided with automatic spindle reverse to permit either climb milling or conventional milling, to be used at both ends of the table for pendulum milling. When using conventional milling the fixtures have to be offset and the cutter used.

On the larger machines, spindle speeds are selected by hydraulic gear shift. A small hydraulic motor rocks the gears slowly until they mesh when final engagement takes place by hydraulic pressure. The range of 18 or 21 spindle speeds is provided depending on the size of the machine, from 35½ to 1800, 18 to 1800 or 14 to 1400 rpm. On the smaller machines the shift is manual but a built-in limit switch immediately stops the machine if the operator tries to change speeds whilst the machine is running.

technique

—devoted to the discusssion of practical problems
Readers are invited to contribute items from their own experience in matters relating to design, manufacture and maintenance

Geometric Construction of Circles in Squares in Perspective Projection

A circle viewed in perspective is a true ellipse, the centre of the circle being offset. Fig. 1 indicates that the view is a plane section of an elliptic cone and analytic geometry shows that this is a true ellipse (this does not apply to panoramic views). The true centre of the circle is usually found and then approximate methods used to determine the dimensions of the ellipse, which actually apply to an ellipse in a parallelogram but are erroneously indicated as exact in perspective.

An exact construction was evolved by employing well-founded geometric principles, chiefly Pascal's theorem and projective geometry.

To construct a circle in a square in perspective projection (Fig. 2)

Let A and B be the vanishing points of quadrilateral CDEF, the square drawn in perspective with respect to horizon line AB.

1. Join CE and DF giving perspective centre O of the circle.
2. Join AO and BO giving points of tangency R,S,T and U.
3. Draw arbitrary construction line BQ.
4. Draw construction lines RU and SU cutting BQ at m and n respectively.
5. Draw construction lines Rn and Sm intersecting at P, a point on the required ellipse.
6. By varying the direction of BQ the whole ellipse may be plotted two points at a time.

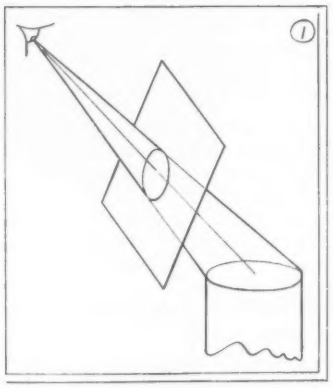


Fig. 1.—Perspective projection of circle

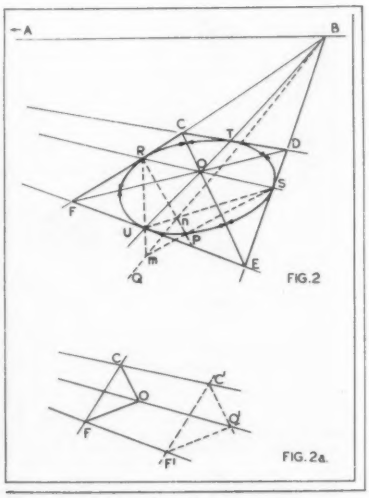


Fig. 2.—Plotting circle in perspective

30-TON ROTATOR.—This Yates 30-ton self-aligning rotator for automatic welding is the first of its kind for it incorporates a patented floating friction safety drive which prevents possible damage to gearing and motors when loading vessels on to the machine. It also provides protection against mechanical damage should the machine become overloaded. Also incorporated for the first time on a large rotator is a patented anti-creep control which prevents vessels moving endwise during welding. The rotator has dual motor drive and all-electric comprehensive remote control. The picture shows three additional idlers for supporting vessels up to 100 ft long and 16 ft dia. This rotator is now made at Hebburn on Tyne at the Bedewell Works of the Baker Perkins Group, of which Yates Plant Limited is a member

If A is accessible it is preferable to plot the ellipse in both directions from R,S,T and U, meeting on the diagonals CE and DF. If A is inaccessible the same construction may be used by employing a centro-lineade or alternately the construction shown in Fig. 2 (a), drawing the sides of the triangle $C^1O^1F^1$ parallel to COF.

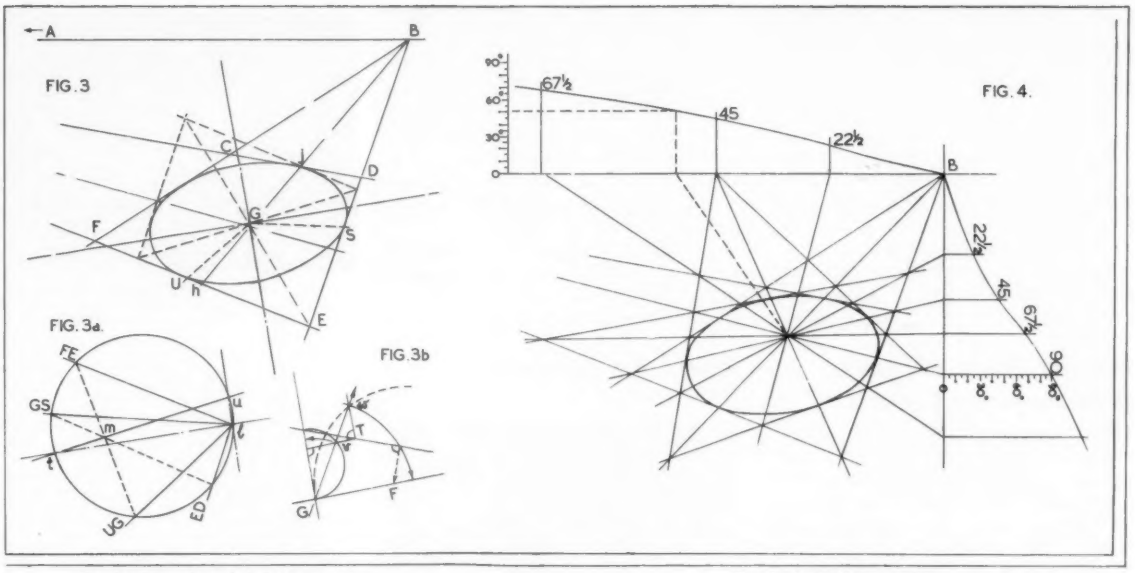


Fig. 3.—Dimensions of circle in perspective

Fig. 4.—Angles in perspective

To determine the dimensions of the ellipse (Fig. 3)

A. Centre.

1. Bisect FE at h.
2. Join hB intersecting CD at j.
3. Through j draw straight line parallel to EF.
4. Repeat construction with respect to DE giving parallelogram.
5. Draw diagonals of parallelogram intersecting at G, the centre of the required ellipse.

B. Direction of axes.

1. Draw an auxiliary circle approximately equal in size to the quadrilateral (Fig. 3a).
2. Draw straight lines parallel to EF, ED, UG, GS concurrent on the circumference at l and cross join their intersections giving intersection m.
3. Draw diameter of circle through m intersecting circumference at t and u.
4. Join tl.
5. Major axis is parallel to tl and minor axis is parallel to lu but more accurately drawn perpendicular to tl.

C. Lengths of axes.

The lengths of the axes may be determined from a point T where a tangent touches the ellipse in a similar manner to that used for an ellipse in a parallelogram. Referring to Fig. 3b semicircles are drawn on the intercepts of the tangent with the axes intersecting perpendiculars from T at v and w. Gw and Gv are the lengths of the major and minor semi-axes respectively. If it is not practical to draw the larger semicircle, w may be determined by drawing Gv and producing as shown.

D. Circumference.

The ellipse may be plotted by any exact or approximate method, by ellipsograph or by templates. Considering geometric methods, the circles of radii Gw and Gv may be drawn with centre G and the triangle wTv repeated for a series of positions of Gw on the circumference of the major circle. If it is desired to use the "string" method of plotting the ellipse, the foci for inserting the pins may be determined by a perpendicular from the intersection of the tangent with the arc struck by the radius Gw, giving one focus at F and the other at an equal distance from G.

To plot angles in perspective (Fig. 4)

The construction of Fig. 1 or Fig. 2 should first be used to obtain the intersections of the ellipse with the diagonals of the containing rectangle. The remaining sides of the containing octagon are next drawn through the points of tangency and meeting the diagonals of the quadrilateral on the line AB. One of these points is usually inaccessible but the lines may be drawn through the relevant intersections. Straight lines are next drawn through the newly formed corners of the containing octagon dividing the circle into 16 equal parts (true), the numerous intersections giving a cross-check on the accuracy of construction.

The radial lines are continued to AB or a perpendicular at B as shown and a graph drawn for the angles in each quadrant. If necessary one may be shortened and the other extended by $22\frac{1}{2}°$ as in the example.

A particular angle may then be interpolated or a series of markings applied e.g. protractor markings, clockface positions, compass directions, gear teeth, wheel spokes and the like.

—W.H.S.

Automatic CO_2 Welding in Shipbuilding

A new type of automatic welding equipment now in operation in the Haverton Hill Shipyard of the Furness Shipbuilding Company Limited, on Tees-side, is a self-propelled twin-fillet machine designed and made at the Gateshead Works of Quasi-Arc Limited. It has a self-propelled carriage on which are mounted two automatic Fusarc/CO_2 welding heads, enabling twin horizontal-vertical fillet welds to be made simultaneously as the machine traverses at welding speed.

Traversing speed is from 12 and 36 in. per min with a maximum welding speed of about 26 in. per min; at least 800 ft of fillet weld per shift with a leg length of 0·265 in. is being produced, this fillet size replacing a normal $\frac{5}{16}$ in. manual weld because of the deep penetration characteristics of the automatic process.

Three of these machines are being used for welding stiffeners to bulkhead panels for oil tankers of 33,000 and 40,000 tons deadweight. It is

reported that the likelihood of distortion due to welding is considerably reduced and no pre-setting of plates is required. The machines will also be used shortly for the fabrication of large T-section stiffeners for the bottom shell longitudinals. On one ship alone the three twin-fillet welders will carry out a total of about 120,000 ft of fillet welding, with a considerable saving in time.

An important feature is the self-guiding action by which the welding heads are automatically aligned on the stiffener webs, following them accurately even when there is waviness in the horizontal or vertical plates. Particular attention has also been paid to ease of manœuvring and setting-up, and the balance of the twin-fillet welder is such that it can, in fact, be handled more quickly and easily than many single-headed machines. The equipment can be tilted safely backwards on to a stand, enabling maintenance and adjustments to be carried out conveniently on the welding heads and nozzles.

Band Saw Repair Methods to Reduce Operating Costs

The cutting of hardwoods inevitably increases the wear on band and circular saws, and this, together with the broken teeth and cracks caused by foreign bodies, has opened a new field for flame welding. One of the pioneer firms in the technique of welding band saws is William Brown and Company (Ipswich) Limited, who import and cut large quantities of timber of all types. They have found that welding saves time and reduces operating costs, and have adopted the following methods as routine procedure.

The traditional method of dealing with a crack in a band saw is to cut the cracked section out, making a brazed lapground scarf-joint. Fusion welding is quicker than lap-jointing and does not reduce the length of the saw. Copper-coated mild steel rod, with a modified leftward technique, is employed. Post-weld tempering to remove hard spots, completes the repair.

Hard foreign matter, such as pieces of metal embedded in timber, often means the loss of teeth in a band saw. Repair by removal of the remaining saw teeth and recutting the blade is a costly operation and reduces the width of the saw by at least an inch. Saws with up to 20 teeth missing have been repaired by filing away the broken teeth and welding in replacements. Each tooth is tacked in place in a jig, after which the weld is completed by using a leftward technique—welding from right to left.

Hard-tipping of band saw teeth with Grade-12 Stellite has also proved to be economical where band saws are used on hard woods, especially those now imported from Africa and the Far East—Krabak, Roko, Keruing, Gurjan, Abura and Mansonia. Stellite tipped saws have given up to ten times their normal

Hard-tipping of saw teeth has made it possible for up to 10 times the normal use of a saw before teeth need to be resharpened. The teeth can also be resharpened several times before re-tipping is necessary

service before being resharpened, and their teeth can be resharpened several times before retipping is necessary. Each tooth is specially prepared before the Stellite tip is sweated on with a carburizing flame. The saw teeth are then individually tempered to reduce local hardness and brittleness in the base metal.

Soluble Fluid for Heavy Machining

Heavy machining operations generally require the use of a neat oil for the cutting lubricant to secure adequate tool life. Recently, however, Bristol Commercial Vehicles Limited have substituted a soluble cutting fluid for neat oil on a heavy operation without loss of tool life. The work is the roughing and finishing of rear wheel hubs from mild steel forgings, and the soluble fluid, which

The sort of heavy cutting seen here is generally accompanied by a flood of neat oil. In this case the soluble oil is being used successfully

is used at a dilution of 12 to 1, is Dixol 25 made by Wakefield-Dick Industrial Oils Limited.

The work is done on two B.S.A., 5D, P & J chucking automatics. The first machine does the complete turning, forming and boring of the brake drum side of the hub, removing 64 lb of material in 64 min. The special form tool used is 6 in. wide and the forming operation is particularly severe. The second machine deals with the other side of the hub and removes a further 17 lb of material.

Measuring Corrosion with Radio-activated Sample

Internally cooled steel probes are in general use for the estimation of corrosion rates of cooled surfaces exposed to flue gases. By using a radioactivated probe the metal lost during a test may be estimated by a count of the radioactivity of the probe washings. Dr. D. Anson of Shell Research Limited describes such a probe in a paper, "A Radioactive Corrosion Probe", read to The Institute of Fuel on February 4, and suggests that it may be possible to develop a probe on this principle to give a continuous indication of corrosivity.

In the prototype probe the test piece is a short mild steel cylinder with thermocouple wires attached and clamped concentrically by a cap nut to the end of the probe. Consistent results are obtained so long as the probe is in constant use, there being a high iron loss in the initial test after a period of disuse. By using the probe continuously there was no need for polishing, which would have been impossible by ordinary means with a radioactivated probe. The radioactive iron (Fe^{59}) content of the washings from the probe was de-

termined by measuring its activity above the normal background count, a calibration of specific calibration being made daily with the aid of a standard solution of a piece of iron which had been irradiated with the test piece.

Stereophonic equipment is assembled on this Glide-wheel equipped production line at the Hayes factory of E.M.I. Sales & Service Limited. The style of construction with Dexion angle is shown and also a section of track passing three testing booths. Rejected units are put on the bottom conveyor and accepted units on the top line

Wheeled Production Conveyor

The stereophonic reproduction equipment made by E.M.I. Sales and Service Limited, Hayes, Middlesex, comes from a highly specialized production line and the accuracy of each operation depends largely upon the operative's access to the conveyor. The equipment adopted for the three runs of complex conveyor, each 130 ft long, is the Dexion Glide-wheel mounted on Dexion slotted angle. The system and the associated racking was built in 50 man days and the construction team were actually at work for less than two weeks. The wheels allow shallow falls and, with its Dexion framework the whole system is fitted round the operation rather than the other way round. If circumstances or production plans change, the layout can be altered or dismantled.

Flame Surface Treatment for Stone

A new use for the oxy-acetylene flame is reported from the United States by the Union Carbide International Company, and concerns the surface finishing of granite. The torch is held about an inch above the surface of the stone which may be covered by a thin film of water. The result is a controlled spalling of small chips which removes saw or other marks. Besides being decorative the surface is said to be practically impervious to all natural elements and to stay cleaner than most wrought materials. The torch is moved at linear speeds of from 24 in. to 100 in. per min, the higher speeds giving the smoother finishes.

Electronic Commutator Undercutting

To obtain smooth and even commutation in an electrical machine it is essential for the insulation between the commutator segments to be cleanly undercut. At the Perivale factory of Hoover Limited this work is now being done with the aid of electronically controlled machines made by E.M.I. Limited, replacing a manual method which required each segment to be indexed by lining up its reflection on a screen, after which the operator used a lever to actuate the cutting mechanism.

Among the various production checks to Hoover-made armatures is a visual inspection when the armature is completed. Originally operators merely had the aid of a table lamp to enable them to see better in conducting this inspection. Recently, however, the company has installed illuminated magnifiers. Light is reflected downwards from the magnifier to the armature from a circle of neon lighting, while the operator views the armature from a large lens giving 250% magnification. The illuminated magnifiers were supplied by Engineering Development Limited of Hemel Hempstead.

In the electronic machines, a ray of light is directed on the commutator and reflected back to a photo-electric cell, different indications being given according to the degree of light reflected by the copper and black insulation. The indications are in turn converted electronically to actuate the mechanism of the machine. When alignment is exact the commutator is stopped from turning and a rotary cutter comes into action and cuts the insulation away. The whole process is automatic; all the operator has to do is insert the armature and start the machine. The installation has made significant savings in operator fatigue, cut down the time of training and is estimated to result in a 30% increase in output.

Lubricant for Pressing Titanium

"Gredag" molybdenum disulphide grease (Grade MP 30) has been adopted as a titanium pressing lubricant by The De Havilland Aircraft Company Limited following comparative tests carried out by their Production Research Department. The lubricants used on the drop hammers when producing hot titanium pressings were costly and were causing trouble on the dies due to molybdenum disulphide build up. The lubricants are necessary to prevent scoring of the pressings.

Problems in Maxima and Minima

The useful application of differential calculus to the determination of maxima and minima is well known to engineers, but it is not usually appreciated that partial differentiation considerably shortens calculation. The method is discussed in relation to engineering practice

By W. H. SHEPPARD, B.Sc.(Eng.)

THIS article deals chiefly with the most economical methods of using sheet metal for the design of boilers, ductwork, tanks and the like, but several examples on the design of tents, ever popular in the teaching of differential calculus are introduced because the methods used and principles evolved are fully applicable to engineering constructions. It is not the purpose of this article to give academic proofs of symetrical properties and it should also be mentioned that the methods described may be applied to more complicated problems such as rates of flow, heat transfer and so forth.

Broadly speaking, problems in sheet metal may be divided into two classes: (a) greatest capacity container from a given blank, (b) greatest capacity container from a given area of used surface, and before tackling any problem it should be clear as to which is required. Although (b) is more fundamental, it is more convenient to deal with (a) first. With regard to (b) the usual method of solution by straight differentiation will be discussed first, followed by an explanation of how partial differentiation may be used considerably to shorten the calculations.

Unless otherwise stated, the word "volume" will be taken to imply contained volume or capacity.

Greatest volume from blank

Rectangular Box (Fig. 1.)—Consider a rectangular sheet as shown in 1(a) with corners cut out to form a box as shown in Fig. 1(b). It is required to determine the dimension x of the square cutaways to give the greatest volume of box.

$$V = x(a-2x)(b-2x)$$
$$= 4x^3-2(a+b)x^2+abx$$
$$\frac{dV}{dx} = 12x^2-4(a+b)x+ab$$
$$\text{equating to 0, } x = \frac{4(a+b)\pm 4\sqrt{a^2-ab+b^2}}{24}$$
$$= \tfrac{1}{6}\left[a+b\pm\sqrt{a^2-ab+b^2}\right]$$

For a real box, only the smaller root is applicable.

For a square box, $a = b$, $x = a/6$.

To analyse the equation for V,

$d^2V/dx^2 = 24x-4(a+b)$ and equating to 0, $x = (a+b)/6$

$d^3V/dx^3 = 24$

Fig. 1(c) shows a plot of the curve. If $a = b$ the curve is tangential to the x axis at $x = \frac{1}{2}a$.

Cone (Fig. 2.)—Consider a cone formed from a blank as shown. In this case the radius R is constant and θ, r or h may be regarded as variable.

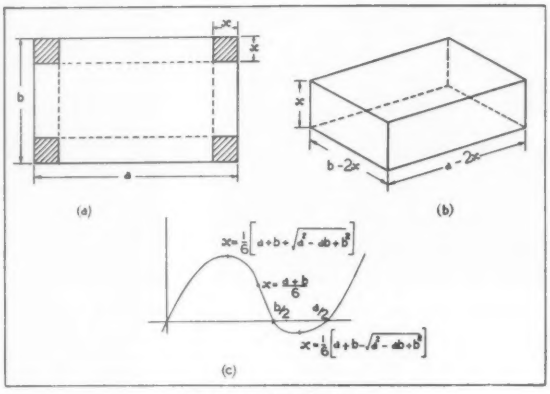


Fig. 1.—Rectangular box

$$V = \tfrac{1}{3}\pi r^2h$$
$$= \tfrac{1}{3}\pi R^3\cos^2\theta\sin\theta$$
$$dV/d\theta = \tfrac{1}{3}\pi R^3\cos\theta(\cos^2\theta-2\sin^2\theta)$$
$$\text{equating to 0, } \tan^2\theta = \tfrac{1}{2}$$

This gives the proportions shown in Fig. 2(b). The angle θ which is of importance in isometric projection has the value 35°16′ and will be given the symbol H. It is given more accurately by $\cos 2\theta = \frac{1}{3}$.

Alternatively h may be regarded as the variable, thus

$$V = \tfrac{1}{3}\pi(R^2-h^2)h$$

and differentiation with respect to h gives the same result in about the same length. In general, differentiation with respect to angular dimensions gives the quickest result but linear dimensions should always be tried, particularly if they avoid roots.

Greatest volume for area used

This problem is essentially the same as determining the least area required to contain a given volume. It will

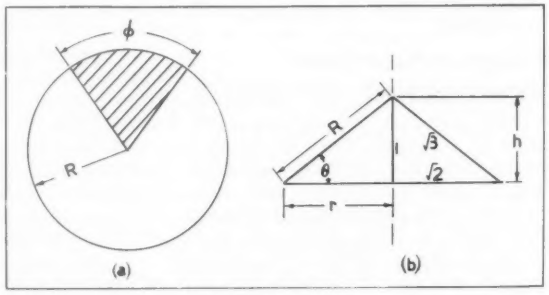


Fig. 2.—Cone from blank

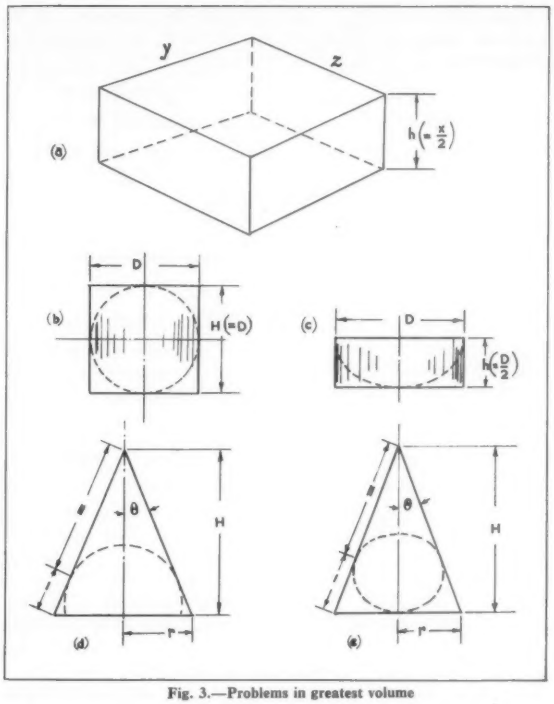


Fig. 3.—Problems in greatest volume

be shown later, however, that if partial differentiation is used, it is immaterial which way the problem is approached, but in this section a few simple cases will be considered, treated as first mentioned.

It will be appreciated that as the area used is considered, the shape of the blank is not taken into account.

Rectangular box. Fig. 3(a).—Unlike the previous examples, the area A must be regarded as a constant and this can lead to considerable difficulty.

Assuming a square planform,

$$V = y^2h$$
$$A = y^2+4yh \text{ or } y(y+4h) \therefore h = (A-y^2)/4y$$

Thence
$$V = y^2(A-y^2)/4y = \tfrac{1}{4}(yA-y^3)$$
$$dV/dy = \tfrac{1}{4}(A-3y^2)$$

equating to 0, $y^2 = \tfrac{1}{3}A = \tfrac{1}{3}(y^2+4yh)$

whence $h = \tfrac{1}{2}y$

Alternatively, regarding V as the constant,

$$A = y^2+4yh = y^2+4V/y$$

which by differentiation and equating to 0 gives the same result. Thus the height of the box is one half the length or breadth and may be regarded as one half a cube or closed box.

Cylinder, closed top. Fig. 3(b)—

$$V = \pi r^2h$$
$$A = 2\pi rh+2\pi r^2 = 2\pi r(h+r)$$
$$h = (A-2\pi r^2)/2\pi r$$
$$V = \pi r^2(A-2\pi r^2)/2\pi r = \tfrac{1}{2}rA-\pi r^3$$
$$dV/dr = \tfrac{1}{2}A-3\pi r^2$$

equating to 0, $A = 6\pi r^2$ whence $H = D$

Thus cylinder has a square elevation.

Cylinder, open top. Fig. 3(c).—

$$V = \pi r^2h$$
$$A = \pi r^2+2\pi rh$$
$$h = (A-\pi r^2)/2\pi r$$

proceeding in a similar manner,

$$h = r \text{ or } H = \tfrac{1}{2}D$$

Thus cylinder has elevation half a square and may be regarded as half a fully enclosed cylinder.

Cone, open bottom or considering only curved surface. Fig. 3(d).—

$$V = \tfrac{1}{3}\pi r^3\cot\theta$$
$$A = \pi r^2\operatorname{cosec}\theta$$
$$r = [(A/\pi)\sin\theta]^{1/2}$$
$$V = (\pi/3)(\cos\theta/\sin\theta)(A/\pi)^{3/2}\sin^{3/2}\theta$$
$$dV/d\theta = \pi(\sin^{1/2}\theta\sin\theta+\cos\theta\tfrac{1}{2}\sin^{1/2}\theta\cos\theta)$$

equating to 0, $\tfrac{1}{2}\cos^2\theta\sin^{1/2}\theta = \sin^{3/2}\theta$

$$\tan\theta = 1/\sqrt{2} \text{ or } \theta = \Theta$$

Now since this angle is the angle of isometric projection of a cube, this cone is that which will fit into the corner formed by three mutually perpendicular planes. It will be noted that the semi-vertical angle (which when referred to in this respect will in future be called the vertical angle) is equal to the base angle when considering the total area of blank as in the previous section.

Alternatively

$$V = \tfrac{1}{3}\pi r^2h$$
$$r^2 = 3V/\pi h$$
$$A = \pi r(h^2+r^2)^{1/2} = \pi(h^2+3V/\pi h)^{1/2}(3V/\pi h)^{1/2}$$

eventually giving same result.

Cone, closed bottom or considering whole surface. Fig. 3(e).—

$$A = \pi r^2+\pi r^2\operatorname{cosec}\theta = \pi r^2(1+\operatorname{cosec}\theta)$$
$$V = \frac{\pi A^{3/2}\cot\theta}{3\pi^{3/2}(1+\operatorname{cosec}\theta)^{3/2}}$$

Differentiation and equating to θ gives eventually

$$\sin\theta = \tfrac{1}{3} \quad \theta = 19°27'$$

Square pyramid.—Similar calculations give $\theta = \Theta$ for an open bottom pyramid or $\sin\theta = \tfrac{1}{3}$ for a closed bottom. Thus it may be inferred that any regular pyramid may be regarded for these purposes as a cone with sides sloping at angle as calculated therefore.

General note.—Considering the results obtained it will be observed that the volumes may be regarded as touching a sphere at the centre of area of each surface, curved surfaces being regarded as a series of elemental flats. Open ended volumes are regarded either as half the double volume or with respect to a hemisphere. These hypothetical spheres are shown in Fig. 3, but were omitted from mention in the text to clarify the explanation.

Use of partial differentiation

It will be realized when considering the previous examples that the greatest difficulty occurs in regarding the area or volume as constant, when actually they may both vary. Use of partial differentiation eliminates this

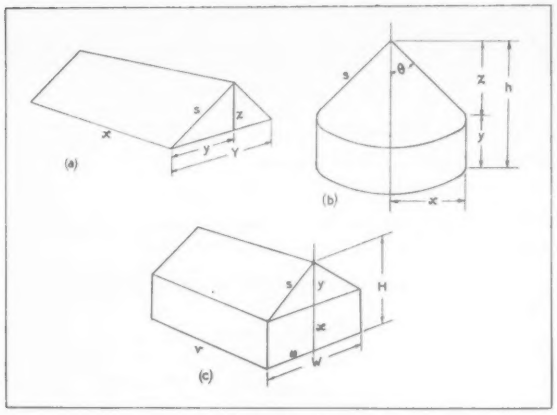


Fig. 4.—Tent problems

trouble. How this is performed will be demonstrated by a simple example. Consider a cylinder of radius r and height h.

$$\text{Volume } V = \pi r^2 h$$

V is a function of r and h.

If h is regarded as a constant, $dV/dr = 2\pi r$ and this is written as $\delta V/\delta r = 2\pi r$, i.e. the partial differential coefficient of V with respect to r.

Alternatively, if r is regarded as constant, $\delta V/\delta h = \pi r^2$, i.e. the partial differential coefficient of V with respect to h.

It is shown in books on calculus that

$$\frac{dV}{dr} = \frac{\delta V}{\delta r} + \frac{\delta V}{\delta h} \cdot \frac{dh}{dr}$$

Thus if the relation between h and r is known, dV/dr or dV/dh may be determined.

In general however, let $V = F(xy)$ and $A = f(xy)$

Considering $A = f(xy)$, again it is shown in books on calculus

$$\frac{dy}{dx} = -\frac{\delta A/\delta x}{\delta A/\delta y}$$

(the negative sign should be particularly noted)

Considering F(xy),

$$\frac{dV}{dx} = \frac{\delta V}{\delta x} + \frac{\delta V}{\delta y} \cdot \frac{dy}{dx}$$

$$= \frac{\delta V}{\delta x} - \frac{\delta V}{\delta y} \cdot \frac{\delta A/\delta x}{\delta A/\delta y}$$

Equating to 0, $\dfrac{\delta V/\delta x}{\delta V/\delta y} = \dfrac{\delta A/\delta x}{\delta A/\delta y}$

This formula may be used for the previous problems and greatly simplifies more difficult problems. To simplify the explanation, certain previous examples will be repeated using this equation which will then be used for more difficult cases.

It may be inferred also, that if several variables are considered, x, y, z. . . .

$$\frac{\delta V/\delta x}{\delta A/\delta x} = \frac{\delta V/\delta y}{\delta A/\delta y} = \frac{\delta V/\delta z}{\delta A/\delta z} \ldots$$

Cone open end. This relatively simple problem will be repeated using the formula just derived, to explain the application.

$V = \frac{1}{3}\pi r^3 \cot\theta$ $\quad A = \pi r^2 \operatorname{cosec}\theta$

$\delta V/\delta r^2 = \pi r^2 \cot\theta$ $\quad \delta A/\delta r = 2\pi r \operatorname{cosec}\theta$

$\delta V/\delta\theta = (-\pi r^3/3)(1/\sin^2\theta$ $\quad \delta A/\delta\theta = -\pi r^2 \cos\theta/\sin^2\theta$

$$\frac{\delta V/\delta r}{\delta V/\delta\theta} = \frac{\delta A/\delta r}{\delta A/\delta\theta}$$

$$3\pi r^2 \cot\theta \sin^2\theta/\pi r^3 = 2\pi r \operatorname{cosec}\theta \sin^2\theta/\pi r^2 \cos\theta$$

$$3\cos^2\theta \sin\theta = 2\sin\theta$$

$$\cos\theta = \sqrt{2/3} \qquad \theta = \Theta \text{ as before.}$$

Bivouac tent, Fig. 4(a).—

$V = xyz$ $\quad A = 2[x(y^2+z^2)^{1/2}+yz]$

$\delta V/\delta x = yz$ $\quad \delta V/\delta y = xz$ $\quad \delta V/\delta z = xy$

$\delta A/\delta x = 2s$ $\quad \delta A/\delta y = 2[(xy/s)+z]$ $\quad \delta A/\delta z = 2[(xz/s)+y]$

$$\frac{yz}{2s} = \frac{xz}{2[(xy/s)+z]} = \frac{xy}{2[(xy/s)+y]}$$

$$(xyz/s)+yz = (xy^2/s)+yz$$

$$z = y \text{ or } Y/2, \text{ whence } x = y\sqrt{2},\ x = s,$$

i.e. tent is a diagonal half of a cube, total vertical angle $= 90^\circ$

Bell tent. Fig. 4(b).—This may be considered as circular or polygonal.

$V = \pi x^2(y+z/3)$ $\quad A = 2\pi[xy+\frac{1}{2}x(x^2+z^2)^{1/2}]$

$\delta V/\delta x = 2\pi x(y+z/3)$ $\quad \delta V/\delta y = \pi x^2$ $\quad \delta V/\delta z = \pi x^2/3$

$\delta A/\delta x = 2\pi[y+\frac{1}{2}(s+x^2/3)]$ $\quad \delta A/zy = 2\pi x$

$\delta A/\delta z = 2\pi xz/2s$

$$\frac{2x(y+z/3)}{y+\frac{1}{2}(s+x^2/s)} = \frac{x^2}{x} = \frac{x^2 2s}{3xz}, \text{ i.e. } z/s = 2/3$$

whence $\cos\theta = 2/3$, $h = s$

Cottage tent Fig. 4(c).—

$V = 2vwx+vwy$ $\quad A = 2vx+4wx+2v(w^2+y^2)^{1/2}+2wy$

$\delta V/\delta v = w(2x+y)$ $\quad \delta V/\delta w = v(2x+y)$

$\delta V/\delta x = 2vw$ $\quad \delta V/\delta y = vw$

$\delta A/\delta v = 2(x+s)$ $\quad \delta A/\delta w = 2(2x+vw/s+y)$

$\delta A/\delta x = 2(v+2w)$ $\quad \delta A/\delta y = 2(vy/s+w)$

$$\frac{w(2x+y)}{x+s} = \frac{v(2x+y)}{2x+vw/s+y} = \frac{2vw}{v+2w} = \frac{vw}{vy/s+w}$$

whence by simplification

$$s = 2y \quad x = y \quad v = 2w$$

or the tent is one half a regular hexagonal prism of length equal to its width. (If the sides were allowed to slope, tent would be one half such an octagonal prism).

Curiously, in both cases of cottage tent and bell tent, the length of the slope is equal to the vertical height. Actually it may be proved geometrically that the length of any tangent to a semi-circle produced to a boundary perpendicular is equal to the height of this point from the centre.

General note.—Considering the results of the above problems in this section, it will be noticed that the surfaces touch a hypothetical hemisphere with diametral

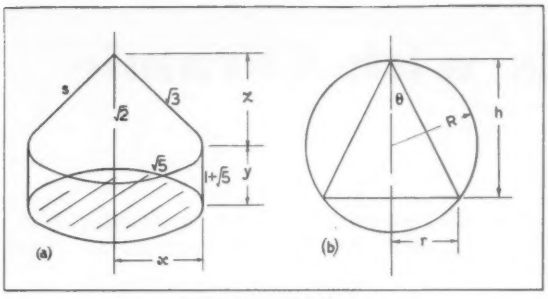


Fig. 5.—General problems

plane on the ground, or volume may be regarded as a half of a figure surrounding a whole sphere. The areas touch the sphere at their centres of area (or elements in the case of curved surfaces). In Examples 3 and 4, if the width and area are both fixed, the height will be such as to give the same inclination of roof and this principle may be employed in the design of ends for tubular containers, in which case the hypothetical sphere will lodge in each end with surfaces tangential at their centres.

It is not always possible, however, for the surfaces of a figure to touch a sphere. This is particularly true of inclined pyramids and a few examples will now be considered.

Bell tent, including floor covering, Fig. 5(a).—In this case there is an extra area of the floor, πr^2, giving the modified equation.

$$\frac{2(y+z/3)}{x+y+\frac{1}{2}(x^2/s+s)} = 1 = 2s/3z$$

and again by simplification

$$\text{Cos}\theta = 2/3 \text{ as before}$$

but $y = 1+\sqrt{5} = 1{\cdot}224$

Another type of problem will now be considered which although largely academic in character, shows how the method of partial differentiation may be applied.

Cone in sphere, Fig. 5(b).—To determine the largest volume cone for a given radius.

In this case R is the constant upon which the relative values of h and r depend.

$$V = \tfrac{1}{3}\pi r^2 h \qquad R = \frac{h}{2} + \frac{r^2}{2h}$$

$$\delta V/\delta r = \tfrac{2}{3}\pi r h \qquad \delta V/\delta h = \tfrac{1}{3}\pi r^2$$

$$\delta R/\delta r = \frac{r}{h} \qquad \delta R/\delta h = \tfrac{1}{2}\left(1-\frac{r^2}{h^2}\right)$$

$$\frac{2\pi r h^2}{3r} = \frac{2\pi r^2 h^2}{3(h^2-r^2}$$

$$h = \sqrt{2}r \quad \theta = \Theta$$

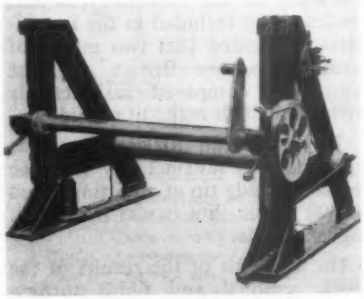
By similar calculation it may be shown that the largest cylinder in a sphere is when the angle formed at the centre is given by $\theta = 90-\Theta$. The largest cylinder that can be inscribed in a cone is one third of its height or at centre of elements, but this problem is better solved by simple differentiation.

Conclusion

In general it will be seen that the most economical designs are those where the faces touch a hypothetical sphere at their centres of area (or hemisphere for open ends). General problems, however, may be solved by the formula derived involving partial differentiation. It is hoped that these results will be of value to those concerned in such design and help them to avoid the tedious calculations from first principles often used.

Hydraulic Pay-out Drumstand

For carrying an additional stranded core or lead-in wire to stranding machines or extruding lines, Larmuth & Bulmer Limited, Salford, Lancs., have developed an adaptable hydraulic pay-out drumstand which is designed to simplify loading operations. The support bearing for the through shaft can be locked by hand in various positions so that the drum is simply rolled into place ready for lifting by hydraulic jacks. The jacks can be hand or foot operated or by a push button controlled hydraulic accumulator system and as the tensioning device is fitted independent of the through shaft, there is no need to dismantle tensioning when changing a drum.



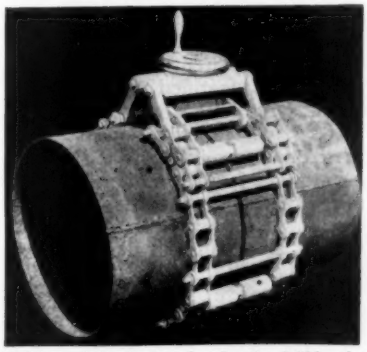
The LB hydraulic pay-out drumstand

The LB hydraulic pay-out drumstand is made in five standard sizes ranging from drum diameters of 2 to 10 ft and weights up to 10 ton. To increase the diversity of each drumstand two through shafts of differing diameters are supplied; size A, for example, will carry any drum from 2 to 4 ft dia with weights up to 2 ton and the largest size, G, will accommodate drums from 6 to 10 ft dia with weights up to 10 ton.

Widely Adjustable Pipe Clamps

A range of adjustable pipe clamps which will accommodate wide ranges of pipe sizes has been designed by Courtburn Positioners Limited, Kempston Hardwick, Bedford.

Three sizes of clamp are available to accommodate all pipes from 6 to 24 in. but larger sizes can be made if required.



Holding and aligning two short lengths of 10 in. pipe with a model 612 Courtburn adjustable pipe clamp

The clamp is wrapped round the two butted pipe ends to be welded, double claws are engaged on the nearest distance piece, and the handwheel turned until the clamp grips the pipe ends in perfect alignment for butt welding. Ample accessibility is provided for tacking all round the pipes, and space can be left between the pipe ends for the weld filler as required.

Turning Alloy Steels with Ceramic and Carbide Tools

Investigation at PERA shows that ceramic tools can be used successfully at high stock removal rates and that they may be superior for finish turning

ALTHOUGH ceramic tipped, single point tools have been available in Great Britain for several years, their use was on a restricted basis until comparatively recently, and the wide differences in views about the potentialities of ceramic tools and the marked interest shown by cutting tool users led to the sponsored research programme described in a report by the Production Engineering Research Association with the object of determining and comparing the performance, in terms of tool life and work surface finish, of various "clamped-on" ceramic and carbide tips, when turning 45—65 ton/sq. in. U.T.S. alloy steels.

Eight makes of ceramic tip (British and American) were tested, and two of the British makers supplied three different grades. One British and one American make of carbide tip were included in the tests, for comparison.

Each was identified by a code letter and different grades of one make were identified by subsidiary numbers and letters, e.g., J2a.

The stock removal tests were carried out at 800 ft/min and 0·0066 in./rev; and 1,200 ft/min and 0·0044 in./rev. These combinations gave a constant removal rate of 6·4 cu. in./min, at a constant depth of cut of 0·1 in.

The negative rake/positive rake comparison tests were carried out at 400 ft/min and 0·0133 in /rev at 0·1 in. depth of cut.

Additional stock removal tests were carried out, to determine the effect of cutting speed on tool life, at 600 ft/min and 1,200 ft/min at a feed rate of 0·0133 in./rev at 0·1 in. depth of cut.

The finish turning tests were carried out at two cutting speeds 800 and 1,200 ft/min and two feed rates 0·0044 and 0·0066 in./rev, the depth of cut being constant at 0·01 in.

Steel En 28 was used for the stock removal and finish turning tests, En 25 for the preliminary tests and the limited tests to determine the effects of cutting edge side rake on performance, and En 21 for the tests to determine the effect of cutting speed on tool life.

Cutting tools

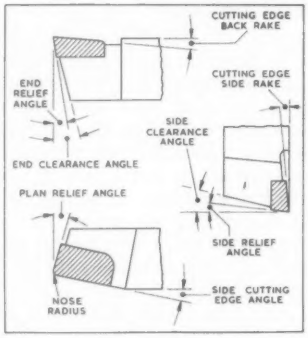
At the commencement of the investigation, the following coded makes were available:

A, B, C, D, E, F, G (American carbide), and W (British carbide).

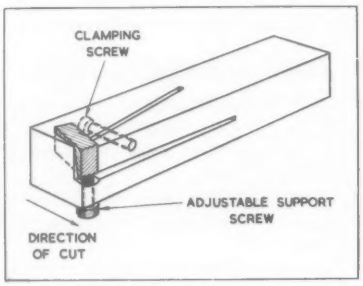
Whilst the tests were in progress other makes of tip were received for inclusion in the investigation. These additional tips could not be included in all tests because insufficient test material was available.

The additional makes of tip were as follows:

H, J1, J2a, J2b, K, F1 and F2.



Tool terminology



Tip holder

The number of tips of each make supplied for the investigation varied from one to six.

All tips except ceramic tip B were approximately 1 in. × $\frac{5}{8}$ in. × $\frac{3}{8}$ in. The $\frac{3}{8}$ in. dimension of all tips was ground to 0·365 in. to enable them to be held in the holder. The tool tips were located and held by the side clamping faces of the tool holder and additional support and location were provided by a vertical adjusting screw in contact with the base of the tip. An intermediate support pad was not used.

The holder presented the tip to the workpiece at the following angles; the nose radius was 0·040 in.

Cutting edge side rake	−6°
Cutting edge back rake	−6°
Side cutting edge angle	15°
Plan relief angle	15°
End relief angle	6°
Side relief angle	6°

Suitable chipbreaker steps were ground on the tips, the actual dimensions depending on the cutting conditions used in each series of tests.

Tip B was approximately $\frac{3}{4}$ in. × $\frac{3}{4}$ in. × $\frac{1}{4}$ in. and therefore could not be adapted to fit the toolholder. As this investigation was of a preliminary nature, it was considered that the shape of this tip would not permit a satisfactory comparison to be made with the other tips.

An overall assessment of the performance of the various types and grades of tip included in the investigation indicated that two makes of ceramic tip, one British and one American, compared satisfactorily with the British make of carbide tip.

The American make of carbide tip compared satisfactorily with the British carbide tip at a cutting speed of 400 ft/min, but it was inferior at higher speeds.

On the basis of the results of the stock removal and finish turning tests, the performance ratings of the

various tips are given below in descending order of merit.

Stock Removal	*Finish Turning*
H	H
A	A
W (carbide)	E
E	W (carbide)
F1	F1
K	F2
D	D
J2b	F
J2a	K
F	J2a
	J2b
G (carbide)	G (carbide)
C	C
J1	J1

Note: (1) Unless stated otherwise code letters refer to ceramic tips.
(2) Makes F1 and K were inserted in the "Stock Removal" order of merit on the basis of the results of the positive/negative rake tests only. Make F2 was not included in any "Stock Removal" tests.

The majority of the stock removal test results indicated that the volume of metal removed was higher and the tool life longer when using the lower speed/higher feed cutting condition, i.e., 800 ft/min, 0·0066 in./rev compared with 1,200 ft/min and 0·0044 in/rev.

800 ft/min and 0·0044 in./rev was the most satisfactory combination of cutting speed and feed rate used when finish turning. The finish turning results were analysed in terms of area of metal machined, the work surface finish obtained and the amount of tool wear which occurred.

Due to the preliminary nature of this investigation, only a limited number of combinations of cutting speeds and feed rates were used and it is therefore not possible to provide fully established conclusions about the most suitable conditions for a given stock removal rate.

There were no marked differences in performance of tips having negative 6° and positive 6° cutting edge side rake.

The relationship between deformed chip thickness and the feed rate is usually defined as the

Chip thickness ratio $= t_1/t_2$

where t_1 = undeformed chip thickness (feed increment)

t_2 = deformed chip thickness.

The chip thickness ratio was independent of cutting tool material at all cutting conditions.

The chip thickness ratios for the stock removal tests, and the finish turning tests, were 0·67 and 1·0 respectively.

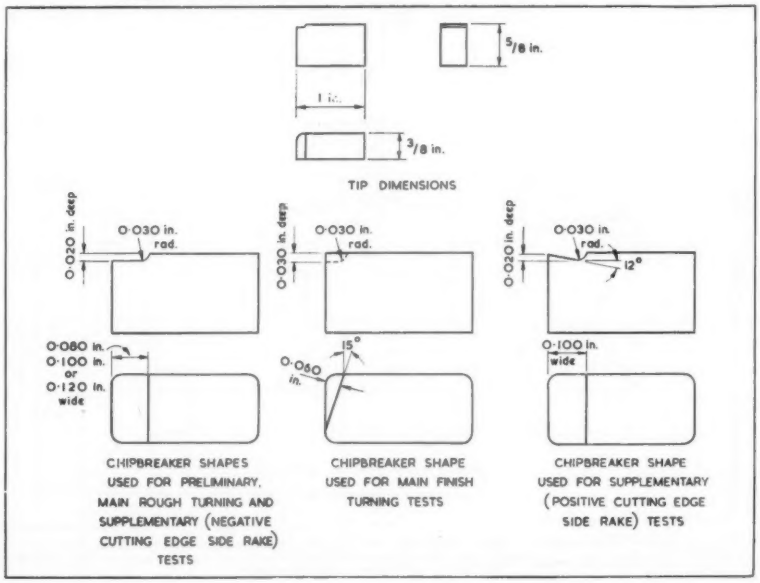
Micrographs of the chips produced at various stages during the life tests on ceramic tip H and carbide tip W, showed that no alteration of average chip thickness occurred when using ceramic tip H and that a marked increase of average chip thickness occurred near the end of the carbide tip life (40 min). This marked increase of chip thickness was associated with severe cratering of the carbide tip, the crater acting as a narrow chipbreaker producing tightly curled chips.

Since 1955, a number of manufacturers have given attention to the problems involved in producing ceramic materials suitable for machining metals. As a result, many experimental grades of ceramic have been produced and it is therefore possible that the manufacturers who supplied the tips used for this investigation have since developed improved materials. Comparative performance tests on tool materials which may subsequently be superseded by improved materials present problems in providing a satisfactory evaluation of their relative properties. In fact, some of the manufacturers who supplied tips for these experiments are still in the development stage and up to the time of writing the report were not selling ceramic tips on a commercial basis.

It should also be mentioned that the British make and grade of carbide tip used for comparison was selected as being representative of tools suitable for turning high tensile alloy steels. In previous comparison tests with other carbides, the performance was very satisfactory. It is possible that other grades of carbide tip would have given equivalent or better standards of comparison.

Although certain ceramics proved superior, the results of the experiments cannot be used to form the basis of specific recommendations. However, the investigation has shown that ceramic tools can be used successfully at high stock removal rates and they may be superior for finish turning in terms of surface finish and tool life based on flank wear.

Chipbreaker shapes



Lubricant Research

A range of modern apparatus for research on lubricating oils and allied products has been installed in the new extension to the Wakefield-Dick laboratories at Hayes, Middlesex, where the volume of research and development work has increased 300% in the last ten years. In the new spectrographic laboratory the equipment includes apparatus which analyzes, spectrographically, the metallic constituents of an oil sample. In the radio-chemical laboratory, research is conducted with the aid of radioactive isotopes. Considerable attention has also been given to the provision of equipment and services for the more routine laboratory work. In the organic laboratory, each chemist is provided with separate compressed air, gas, vacuum and nitrogen supply points and a high-velocity extraction system removes odorous fumes at bench level.

The new extensions will add considerably to the efficiency of the research department with a consequent all-round benefit to the Wakefield Castrol Group of Companies and to the users of their products.

Aids to Presswork

- ***Blanking, Drawing and Piercing a Bell Component***
- ***Dual Bending Tool***
- ***Pressing a Special Bezel Ring***

By JOHN WALLER

THERE are many occasions in the sheet metal workshop when the question arises whether the production of an article by spinning is economical. Though for very small quantities spinning is undoubtedly the cheapest way of shaping a part, those borderline cases where the size is large enough to introduce a doubt as to whether a press tool is not too expensive, and the increase in quantities demanded suggest that spinning is now no longer the best way of manufacturing that particular item, need careful consideration as tooling costs play an important role when meeting a low article cost.

A typical case of this type is illustrated at Fig. 1 where several hundred bell shaped vessels were required in a size which borders on the large to some firms, and any suggestion that more than a single tool is necessary immediately introduces a prohibitive tool cost. In addition to blanking the part from previously sheared sheet—the purchase of material in rolls is much too expensive for such a comparatively small number of details—the tool draws the blank over a punch and finally the top hole is pierced; the bell being ejected as a finished article and no trimming is deemed necessary.

Equipment of this nature appears elaborate and therefore costly, but further investigation after initial thought as to the general design the tool must take, will usually reveal that provided every care is exercised when designing to keep costs to a reasonable minimum, such a press tool is feasible because it does save considerable handling time and the finish is comparable with spinning and close tolerances are undisputed with this form of manufacture.

Fig. 2 portrays a blanking, drawing and piercing tool suitable for this shell, and after the location of the blank in the usual pins or recess, the sheet is held on the face of die A by the pressure pad B, and on this occasion the formed cup was not given a trimming allowance because the article was finally welded to another detail and slight errors due to the drawing process did not create difficulties in this operation.

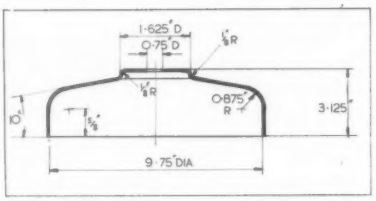


Fig. 1.—A shell of this size is typical of many which make admirable examples for the spinning process, but the cutting of a blank, spinning and finally drilling of the hole is a lengthy and costly series of processes. Ultimately the time arises when the quantity of parts makes it an economical process to produce them by pressing despite the apparent excessive cost of the tooling equipment

After severing the blank the piece is held by the upper punch C and the lower pad D, but as the area under pressure is small, a somewhat higher degree of pressure exerted by the pins E is necessary. At the initial stage of drawing the inner top ejector F is flush with the piercing punch G, but this does not contact the material until the cup has been almost completely drawn to shape.

In order to provide easy assembly of the punch and also to ensure that the head is seating against a hard surface, the top block H is introduced and this is recessed into the upper bolster as shown. By spigoting

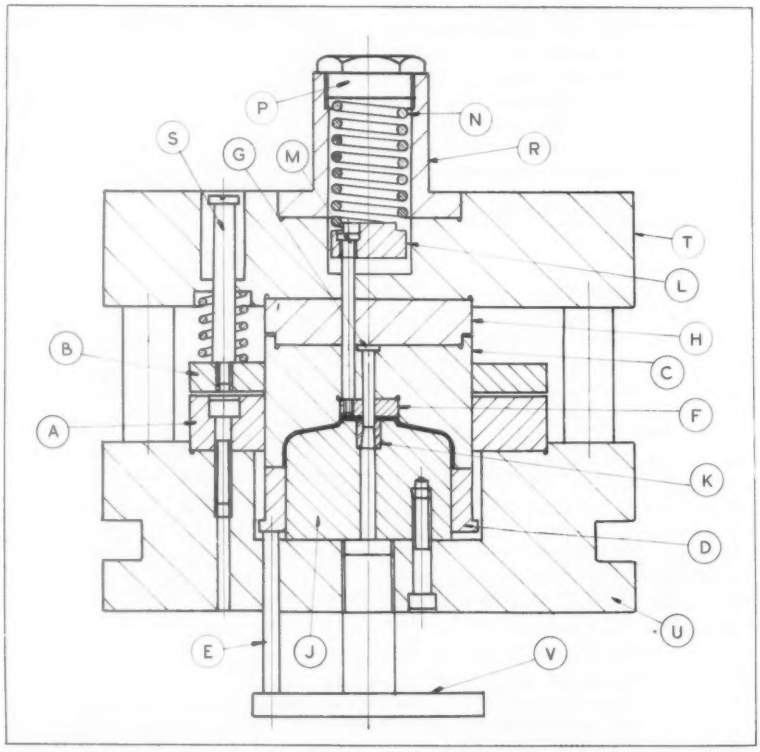


Fig. 2.—Tools of this description appear complicated and therefore expensive to manufacture, but there are many small features which can be removed from the design and so save a considerable expense yet without destroying the general effectiveness of the equipment

the punch C to this item it becomes possible to case harden the contact surface and so prevent the head of the piercing punch from heavily marking the supporting surface. This detail also gives the necessary extension to the forming punch and at the same time overcomes the necessity of having an exceptionally long piercing punch.

The pressure pad D does not on this occasion seat in the bolster as the top tool finally comes to rest when the punch C seats with the material on the lower form punch J; thus there is a clearance between the pad and bottom face of the bolster recess as indicated on this drawing.

For all work of this nature, button dies are usually installed because they simplify manufacture, and this practice has been adopted on this occasion as the dies are easily inserted. The letter K indicates this.

The use of a pneumatic cushion with a central suspension in the form of a tube to allow the scrap slugs to fall clear, is easily carried out by tapping the bolster a suitable thread, but there are other methods of holding the cushion and, in fact, providing the necessary pressure to the pins.

Other items include the spring inside the stalk attached to the upper tool together with the pad L, and this spring is made from fairly heavy gauge material to ensure that a positive ejection is secured from the punch C because failure to achieve this as the tool rises will cause fractures the next time the ram descends. There are three rods M holding the pad and the spring is retained by the hexagonal cap at the top of the stalk.

If considered desirable, and this depends on the quantity of parts being produced by the tool as any additions lead to complications and therefore greater expense, air ejection from off the lower tool is helpful—by this is meant the provision of an air blast to blow the completed shell from the tool into a suitable receptacle, but for the tool in question this was not considered essential and hand removal was utilized.

Despite the apparent complexity of such a design, a tool of this nature generally has one very great advantage provided the article being produced is circular—the manufacture of the various parts is simple and at the most requires only the grinding of a few accurate diameters. Awkward sets on the milling machine for instance, which take up so much time and are therefore costly, are entirely absent, and except for the production of the two formed details which create the dish shape, and which do not exhibit any problems for the centre lathe turner, the manufacture of items on that type of machine tool are in no way complicated.

From these remarks it becomes obvious that pressing is an operation for serious consideration when the number of details required rises and is much preferred to spinning because the speed is so much greater. A tool of this description is not unusually expensive or difficult to produce and the action is simple and effective. Again not all the details require hardening and grinding and this economy is a money saver which tends to assist in reducing the ultimate cost of the equipment.

In contrast to the design and manufacture of jigs and tools, where there are many occasions when a single jig or cutting tool will do service for several similar com-

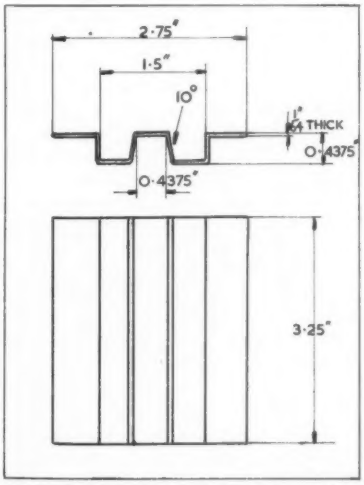


Fig. 3.—Fairly small channel shaped details of the type shown here can be produced with the aid of a single tool despite the need for several corrugations

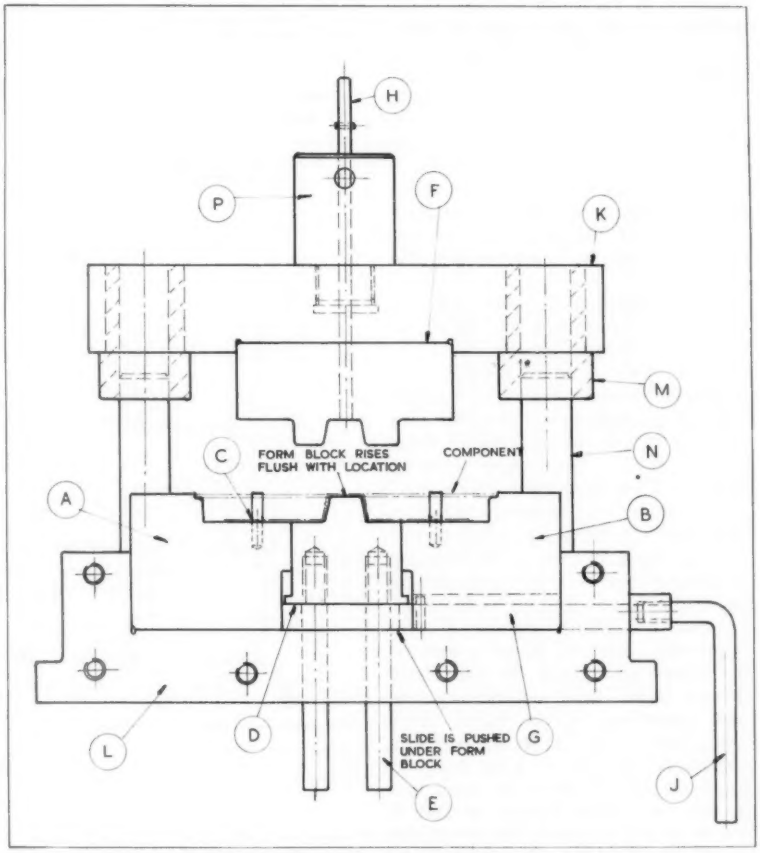


Fig. 4.—The tool arranged for the initial stage. In this setting the slide beneath the form block is pushed home to limit the travel of that member

ponents, examples of the dual type seldom arise in press tool construction chiefly because the very nature of the tools prohibits the use of auxiliary items in the build-up as this can often create a danger to the operator, but on those rare instances when such a situation is possible, the tool usable in a dual category generally provides a design of some considerable interest, and the bending tool seen here is a typical example where the production of a rather awkwardly shaped detail is accomplished by merely withdrawing a slide from beneath the forming die to modify the shape of that member.

Fig. 3 illustrates a sheet metal detail in which two channels are pressed—an operation which is usually carried out in the larger sizes of plate with the aid of a V-tool and using various settings until the final shape is achieved. The smaller plates are not, however, economically produced in this manner; for the larger details tooling costs are high and the quantity of pieces does justify the expense, but for an example of these dimensions a different design of tool is essential in an endeavour to reduce the number of handlings necessary for the production of the part. In this particular case after the initial cutting to a rectangular form, it was visualized that two pressings were possible, and the tool for such work would follow more or less orthodox lines at a reasonable cost per piece.

Fig. 4 portrays the tool with the side plates removed in order to show the details clearly, and the plate is first located between the ledges in the dies A and B; a crosswise location being obtained by pins inserted in the lower faces of these blocks at C. The lower forming member D is then raised to a level as shown by the chain dotted lines and pins operated by a pneumatic cushion hold it there until the top member of this tool descends and so causes the punch to depress block D.

This descending punch F will eventually cause the plate to assume the shape illustrated by the chain dotted lines, thus completing the first operation on the blank. This rising form block D lifts the partially completed component once again to the level of the channel machined in the two outer blocks A and B where it can be easily lifted off the inverted V of the forming block: there is no need for a mechanical ejection device or even the use of an air blast.

The design centres around the slide G, shown in Fig. 4, pushed under the lower sliding form block D. By introducing this slide the amount of movement obtainable with the block is restricted and the surfaces adjacent to the V portion finally come to rest flush with the fixed die blocks A and B. Incidentally the handle attached to this slide is shown in a downwards position for purpose of illustration but in the actual assembly the handle would be in a horizontal position to clear the press bed.

Despite the fact that the tapered sides of this pressing facilitate ejection of the part, the incorporation of a knock-out through the upper details of this tool is feasible, and this is depicted at H, and is presented from falling out when the ram ascends by the pin driven into a crosswise drilled hole in the ejector.

With all forming tools there is always a risk of skidding of the blank and to some extent the same condition arises with the various parts producing the article, consequently the setting of the upper punch and the lower dies in grooves or slots machined in the bolsters is useful because when a tight fit is secured there is less risk of disturbance as when a dowel is used. The use of side plates will properly "nest" the die parts and completely overcome any tendency of movement despite the use of several pieces.

The second operation, though similar to the initial stage, differs first in the method of location and secondly in that slide G is withdrawn to give a greater depth of pocket for the forming member D. The slide is pulled back manually until the small silver steel pin makes contact with the side wall of the bolster—this precaution is necessary and in the advent of any tool of this design being applied for the production of many thousands of parts, some holding medium is essential to stop continued vibration from causing the slide moving inwards and so allowing the descending form block to clip the slide. Such a possibility will undoubtedly render the details liable to breakage. However, for small quantities there is generally more opportunity to observe the tool in action and a refinement of this nature is not necessary. A spring loaded plunger is the obvious idea for such a device

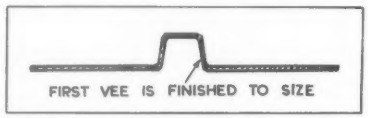


Fig. 5.—The first pressing produces this shape—a central channel with tapered sides

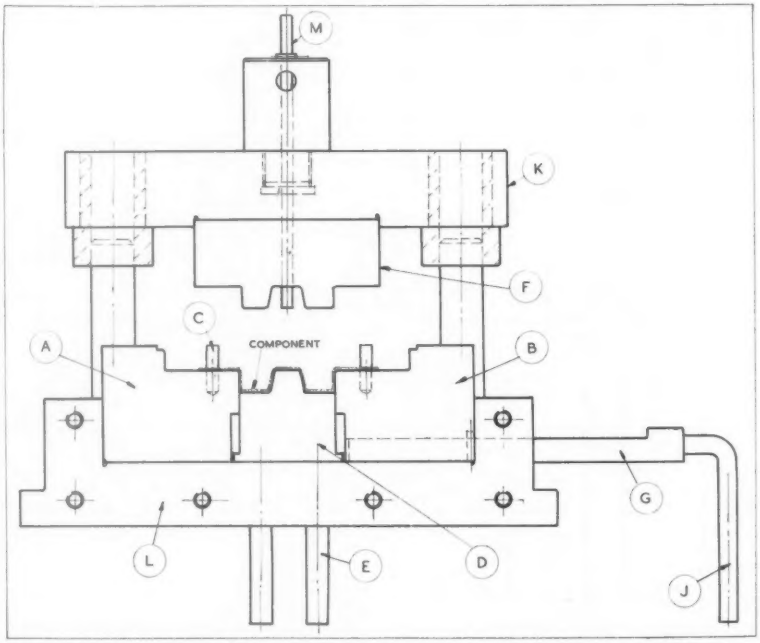


Fig. 6.—When the slide beneath the forming block is withdrawn a clear space is left below the block which allows the top member to push it farther down into the tool. The two remaining channels are thus formed as depicted in the first illustration

and this is easily arranged in the bolster and withdrawn by a handle passing through the side.

Fig. 6 shows the forming block D in the lower position with the punch raised—a situation that cannot occur as the former is controlled by the pneumatic cushion under the press bed and must rise when the ram changes direction, but the illustration shows the increased space at the top of the forming block into which the component has been pressed.

With all bending tools a precise blow with the top tool is needed to "set" the profile, but in this instance this was not a serious point; some stiffening of the plate being needed rather than accuracy of shape. Overbending to a certain extent is feasible in the long arms of the profile by introducing a certain degree of angularity to the top surfaces of the blocks A and B, but in this case it did not prove necessary.

Stripping the part is again a simple matter as the rising form block D lifts the detail from the vicinity of the die members and leaves it in the same position as the first operation where a hand pick-off is performed.

Generally, a tool of this nature is unsuitable for really accurate bending—spring back is not easy to overcome in the final stages and if perfectly vertical sides are essential to the channel portions, then V tooling is the obvious solution. Admittedly a slight overbending is feasible on the faces of the die blocks, but this does not create a right angle at the lower corners of the channels, thus though the tool can advantageously produce this type of workpiece, care is necessary when it comes to choosing the design of part for production. Again, lengthy sheets will naturally demand a long press tool with the complications of incorporating various pins to contact the pneumatic cushion—in fact the need for two or three of these is soon readily apparent—but for details approximating in size to that shown here, such a tool is a cheap and effective way of pressing a sheet and certainly preferable to the V tool which requires more operations before the part is finished.

Reverse drawing is not often encountered in the press shop engaged on the production of formed pieces, shallow draws and blanked items, thus the necessity to produce a workpiece which had all the appearances of a shallow draw but with the reverse drawing technique as the method of production, did present a somewhat unusual opportunity.

Fig. 7 gives the dimensions of this detail, which was circular in shape and had an indentation in the form of a centre boss, and the edges a pronounced curl into which a rubber ring was eventually fitted. No difficulties were anticipated though it was appreciated that the tooling costs would exceed those normally set aside for components of this size. The operations envisaged were: blanking from strip material after passing it through a straightener; drawing inside and outside over what is a substantial radius and finally embossing the 2 in. dia in the floor of the ring, this requiring only a slight stretch of the material as the punch reaches the bottom of the stroke.

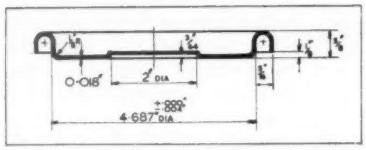


Fig. 7.—Reverse drawing is necessary for the production of this special bezel ring and tooling is more elaborate than is normally associated with blanking and shallow drawing. Embossing is done by a slight stretching of the material during the final stages of the draw

For a tool of this type two heavy bolsters are necessary. In this instance they were of steel and followed conventional lines as depicted at S and T in Fig. 8. The blanking die is large in diameter which makes it essential to utilize a ring of greater thickness than is found in the simple blanking tool, and this detail A is fitted into a recess machined in the lower bolster.

The upper blanking punch has a dual function to perform; in addition to severing the disc of material from the strip, the inner edge has a smooth radius for drawing the outer edge of the disc over the forming punch. The blanking punch B is another ring with a depth of section sufficient to prevent any tendency to twisting, and it is just wide enough to accommodate a series of screws to hold it to the upper bolster. The ring is accurately ground all over on both diameters and at each end.

A similar ring is the pad F which has the important role of controlling

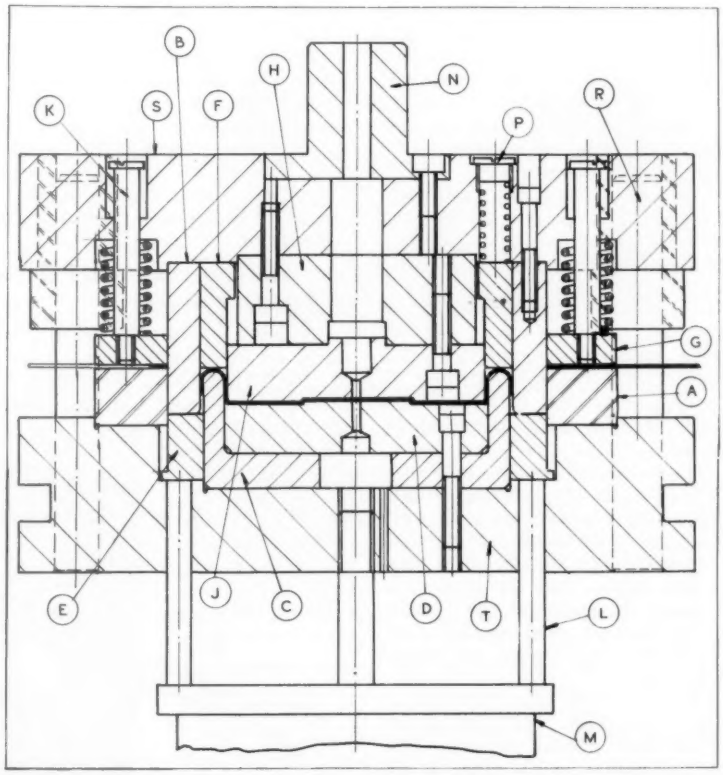


Fig. 8.—Built into two comparatively massive bolsters, accuracy in manufacture is the keynote when producing this class of tool, and the parts are all designed to allow rotary and surface grinding on the important faces and diameters. Special attention is also paid to the escape of air from the operating members as they descend

the material as it flows over the forming die C, and again grinding all over is essential for good working. This detail is, of course, spring loaded, a series of rather heavy gauge springs being inserted in the upper bolster and held there by the headed screw P, a method that facilitates the assembly of the tool and at the same time simplifies the work of drilling the spring holes.

The draw punch J is spigoted to the packing disc H and this creates the necessary step in the diameters which will make a stop face for the pad F when the ram rises and the springs exert their pressure to return it to the initial starting position.

The lower forming die is another two-part affair, C being the part round which the material flows on the way to the die for embossing. This lower die is really a border line case where a single piece construction will give exactly the same results, but the projecting boss for the embossing creates a situation which few tool rooms like to encounter because it means using a small internal wheel for grinding purposes and checking is equally awkward because of the position of the boss. On the other hand the two-part method of making the die prevents the inner corner radius being incorporated, but this is not detrimental to the working of the tool as the disc tends to cling to the punch and so achieve the necessary shape from this rather than from the die radius.

The final detail in the lower construction is the pad E, again of similar shape to the upper member, and this time the controlling movement is secured from the pins L which in turn are actuated by the pneumatic cushion and not by spring pressure as applied to the pad F; while the scrap stripper G is merely a circular disc round the punch B and again operated by springs.

To avoid difficulty with air trapped inside the drawing details, escape drillings are made in both upper and lower sections of the tool, the hole through the stalk N is there for this reason, and the small hole alongside the threaded rod holding the die cushion rids the die of air immediately the blanked disc begins to descend.

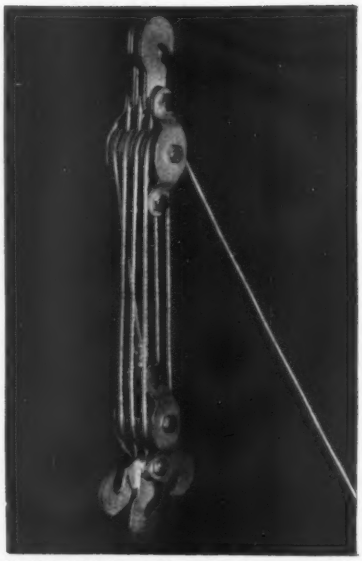
The action of the tool follows normal procedure. The blanked disc is firmly held between the faces of the blanking-cum-drawing punch B and the pad E, and while the former turns over the outer edge of the disc the descending punch J pulls it from between the faces of these details into the die C; thus a flowing action is achieved round the radius and the reverse process is accomplished. Obviously the pressure exerted by the pads is critical—the floor torn from a shell is an indication that too much pressure is being applied and there is jamming of the disc between the two controlling surfaces, but an adjustment to the cushion pressure of a few pounds can materially affect the performance of a tool. For this reason a spring loaded or rubber buffer underneath occasionally seen on equipment of this type is useless. The essential feature with a tool of this design is the complete control of the material during the whole of the drawing together with a comparatively low press speed—about 30 ft per min was, from recollection, the ram speed used when producing this ring. The initial teething trouble was a slight distortion of one of the rings to the extent about 0·0005 to 0·001 in. which caused stickiness during the first run, but after carefully grinding the diameter again to remove this discrepancy the set then began to function well and gave no further trouble.

No trimming was required after pressing as the edge made by the blanking punch and later turned outwards to form the lip of the radial rubber seating was hidden after assembly and the slight irregularities were not sufficient to warrant a special operation to remove them.

Scribing Arcs of 4 to 240 ft Radii

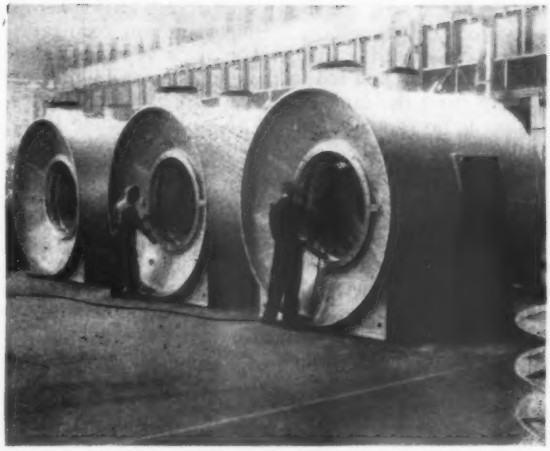
A drafting instrument which will scribe an arc of any radius from 4 to 240 ft has been developed by Triangle Products Limited, Manchester Road, Hyde, Cheshire. The method of using the Arcrola is simple and rapid; one of five master discs which together cover the radii range is selected and fitted to one end of the instrument. The telescopic scale marked on the body is drawn out to the desired radius and locked with a finger screw. Placing the two discs on the radius line and positioning the weight-loaded pencil, the instrument is gently rolled forward producing a clearly drawn arc.

Precisely made with ball-bearing pencil holder and complete with set of 5 master discs in a case, the instrument is priced at £22. The length when fully extended is 29 in, and it weighs 1¾ lb.



MIDGET HOIST.—This useful block and tackle which only weighs 1 lb complete and is so small that it can easily be slipped in the pocket, has been developed by Hattrac Limited, Bourne Works, Weimar Street, London SW15 for domestic and light industrial duties. The entire unit is rustproof, the blocks being of aluminium and the sheaves of solid nylon. The multiple hooks are designed to be self locking and can only be opened when the weight is released. The hoist complete with 72 ft of nylon cord costs 57/6

Triangle Arcrola draughting instrument with five master discs for producing accurate arcs of extensive radii



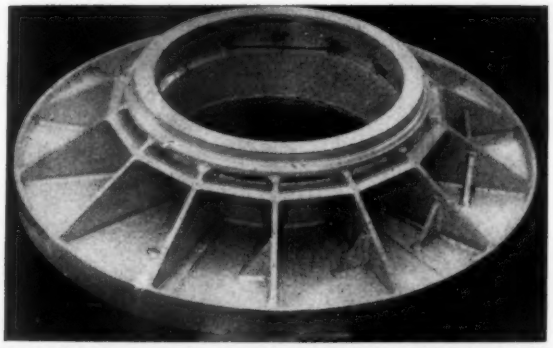


Fig. 1.—Left. Three examples of a device fabricated in aluminium for the U.K. A.E.A. and known as the S.250. It weighs 4½ tons

Fig. 2.—Above. Aluminium welded fabrication in A.W.5 material. Diameter is 8 ft 6 in. and weight 18 cwt. The base is made from 1¼ in. thick rolled plate. The webs are about 1 in. thick

Aluminium and Steel Fabrications for Nuclear Plant

The use of specialized techniques for a diversity of work

THE interests of The Fairey Aviation Company have always been wide, and for the past ten years the company has been strongly involved in other kinds of work, and at the Heaton Chapel (Stockport) works, specialized techniques in the field of aluminium and steel fabrication and welding are now practised where once only conventional methods were used. Production of aluminium fabrications has reached 80 to 100 tons a month, a large proportion of the work having been devoted to producing equipment for the Atomic Energy Authority.

Among the work for the Atomic Energy Authority is a device called the "S 250" (Fig. 1). It is a large aluminium shell consisting of six major fabrications. Material for these is obtained from both Northern Aluminium and the British Aluminium Company. The devices have large domed ends, which are formed in six petal-sections, and which are first routed and formed on a hydraulic press and subsequently welded together after tacking in a jig. These end-pieces have a central core, joined to the rest of the fabrication by web-like side-frames. Another part of the device is a motor mounting, a fabrication of some 18 to 19 cwt which requires apart from the segmented plate work, the rolling, welding, and hydraulic forming of conical rings and the forming and welding of very heavy section bars (Fig. 2). The whole welded assembly was specially developed to replace and improve on the casting technique originally envisaged for this job.

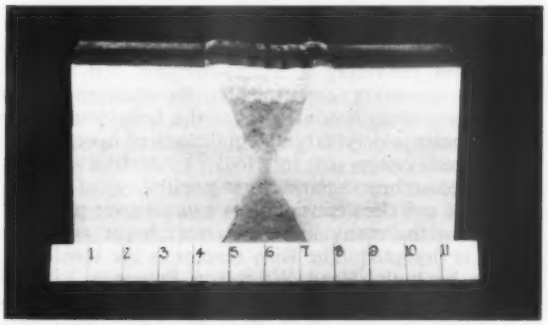


Fig. 3.—Typical weld on A.W.5 aluminium alloy 5½ in. thick. It has very high strength and is free of porosity

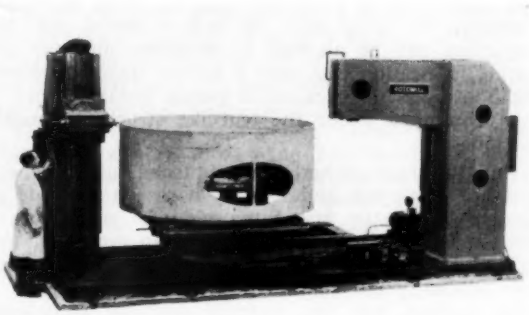


Fig. 4.—The Rotomill designed and manufactured by The Fairey Aviation Company Limited for use on large aluminium fabrications such as this 8 ft 6 in. dia component

These fabrications are welded into their cylindrical housings resulting in a boiler-like structure some 10 ft high and 12 ft long. The total weight is just over 4½ tons complete, which tends to belie the fact that it has been made up from aluminium parts.

A four-piece outlet forms a part of the device and this is formed on a rubber bolster press, which was never

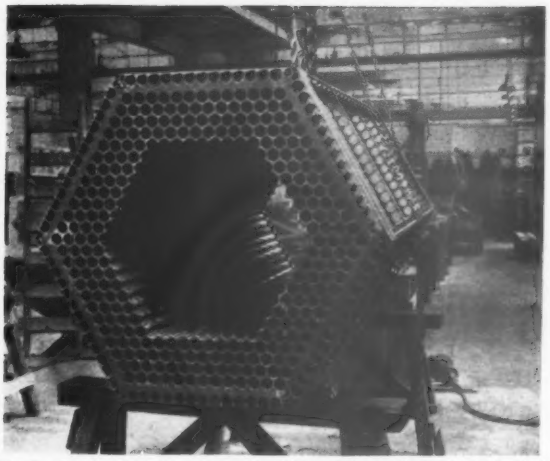


Fig. 5.—Gagging skirt for a fast reactor (Dounreay) manufactured completely in 18/8/1 stainless steel and weighing 30 cwt

originally intended for such work but which has proved valuable for this task. The 4,000-ton bolster press has as its most important feature 21 in. of rubber, which permits the forming of parts half of this depth or approximately 10 in. Apart from being employed on the work for the S.250s, this press has seen more recent use producing motor-car body pressings.

The only steel used on the S.250 is in the feet which support the job.

Clean conditions must be maintained in the workshop and floor area, as might be expected when near-pure materials are being used for such a special job. No impurities can be allowed to penetrate into the job during fabrication and after a certain stage, therefore, the housing is screened-off in plastic booths. Work is then continued under the tent-like structure housing the job.

Both the argon arc and Argonaut techniques have been and are employed, and 5 in. welds are now made as routine. When the first 5 in. weld was performed at Heaton Chapel it was something of an event, for this had never been attempted before. The material welded was originally intended to be produced as part of a large casting, but the material and the techniques developed by the Stockport works at that time demonstrated the possibilities of welding, and since so much was to be gained by eliminating the difficulties associated with castings of this kind the attempt was made. The result was the largest weld produced to date which is shown in Fig. 3.

With the Argonaut technique which is used mainly in the production of the S.250 device the material used in the weld (N 6 wire alloy) is fed through the welding gun automatically from a store positioned above the operator. Three wire thicknesses are used, $\frac{3}{64}$ in., $\frac{1}{16}$ in. and $\frac{3}{32}$ in., and these are fed at a rate of some 230 in/min. The welding guns are water-cooled, as are the cables of the welding unit. The electric power for the motor feeding (pushing) this material supply through the gun is provided from a separate power unit—the output being 250 amp for $\frac{1}{16}$ in. thick wire and 350 amp for $\frac{3}{32}$ in. thickness.

Argon gas, which is stored in liquid form in a central tank, is supplied through tubes to all of the Argonaut welding guns about the shop; its purpose, as is generally known of this technique, being to prevent oxidization of the weld when it is made. The argon is vaporized on leaving the tank and fed to the gun as a gas. A pressure of 40 lb from the tank permits a supply which enables welders to work at the rate of 45 cu ft/hr. Some 12,000 cu ft a week is used.

The 5 in. welds are performed by the Argonaut process. Hundreds will be required before the particular job is completed.

Because of the size of the parts under fabrication, various manipulators, rotators, plate rolls and the like are required to handle the work for welding and for assembly. This equipment also includes facilities for lifting up to 30 tons weight, and there is also a large stress-relieving furnace.

Radial arm machines are used for routing, with 5 hp heads, for work on plates of $1\frac{1}{8}$ in. thickness. For special purposes involving repetitive work, equipment has been developed such as the Rotomill, which has two high-speed cutting heads for removing the stock at a high rate when machining large aluminium components (Fig. 4).

Units of considerable importance have been fabricated in steel and stainless steel for such bodies as the Atomic Energy Authority. These have included structures of up to 80 ft long, such as the scanning gear for the original Windscale reactor, and the core of the Dounreay reactor (Fig. 5), which was built to tool-room tolerances.

Closed-circuit TV for Merlin Reactor

A specially designed underwater industrial television camera for observation inside the Merlin water-moderated nuclear research reactor at Aldermaston has been ordered by Associated Electrical Industries Limited from E.M.I. Electronics Limited. The camera is 30 in. long and $3\frac{1}{2}$ in. dia and will be enclosed in a pure aluminium water-tight housing. It will work in conjuction with a standard E.M.I. camera which is being mounted on top of Merlin to provide a continuous view all round the reactor and to ensure that no unauthorized staff are near the reactor when it is in use. Two ITM 14 viewing monitors will be rack-mounted in the reactor control room and a console monitor, capable of receiving pictures from both cameras, is being installed in the reactor conference room.

Materials Testing Reactor

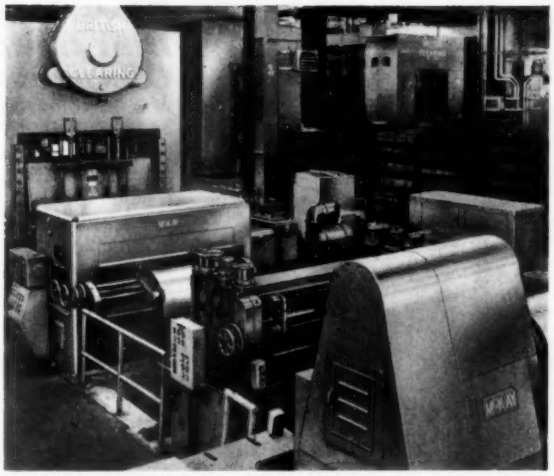
A highly-developed D.R.3. reactor is now under construction at Riso, in Denmark, designed for materials-testing and providing a highly-complex test bed for atomic engineering experiments. Its instrumentation acts to keep a rigid control over the behaviour of the reactor under widely varying conditions of operation. A complicated system of interlocking electrical circuits takes precautions against the possibility of human errors and exercises considerable control over personnel engaged in the many kinds of research for which the reactor is designed. The Riso reactor is the third of its kind to be built. Head Wrightson Processes Limited, are the contractors responsible for the reactor and the instrumentation has been built by Ekco Electronics Limited.

Specialized Brazing Facilities

Specialized brazing requirements which may be desired, but may not justify the installation of costly equipment can now be obtained through the services of Newton Victor Limited, the X-ray department of Metropolitan-Vickers, 132–135 Long Acre, London WC2, who have established a specialized brazing service at Finchley.

The plant provides for the high quality brazing of components in controlled atmospheres and under vacuum. It includes radiation and muffle furnaces, with which temperatures up to about 1800°C can be achieved, so that no torch or flame is needed; these furnaces will handle parts up to approximately 3½ in. square and up to 10 in. long. There are also eddy current furnaces, which give fairly local heating and temperatures in excess of 1100°C, and which are suitable for the brazing of circular components; these will deal with items up to 3½ in. dia and up to 3 ft 6 in. long.

The joints catered for include stainless steel to stainless steel; stainless steel to steel; copper to steel; steel to steel; copper to copper; steel to Nilo K; and Monel to other metals. A method of brazing beryllium has also been developed, and applications for tungsten brazing can be investigated.

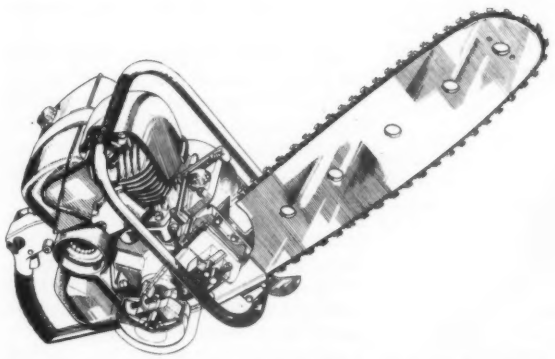


COIL HANDLING AND PRESS FEED LINES—Complete lines for handling coils from 24 up to 108 in. wide and 30 ton in weight have been designed by The McKay Machine Company of Youngstown, Ohio, U.S.A., to feed material at very high speeds either into a guillotine or blanking press. The line is composed of three electrically inter-connected units designed to uncoil and feed pre-set lengths to a high degree of accuracy. Depending on exact requirements, various types of coil holders such as parallel expanding types, cone types and chuck types are employed. When required, high pressure spray pumps for the washing and cleaning of the coiled material can be incorporated. Since the formation of a new company, Vickers-McKay Limited, this equipment will also be manufactured by Vickers-Armstrongs (Engineers) Limited. The selling agents are Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London NW2

One-man Petrol Power Saw Weighing Only 28 lb

Extensive use of light alloy castings and material has been made by J. Clubley Armstrong Danarm Limited, Alford House, Wilton Road, London, SW1, in the production of the Danarm DD 8F Mk II direct drive one-man chain saw which only weighs 28 lb complete and has a cutting speed of 15 sq in./sec.

The power unit of the DD 8F Mk II chain saw is a 5 bhp 100 c.c. petrol engine with direct drive to the



Partly cut-away view of the Danarm DD 8F Mk II chain saw showing the clutch drive

cutter chain. To protect the engine from shock or overload the engine shaft carries a self locking centrifugal clutch in a dust-tight housing. The magneto is totally enclosed and the contact breaker is remotely mounted in an accessible position outside the crankcase. Mounted on the fan casing and engaging with the fan centre is an automatic rewind starter. This mechanism is easily removable to expose a rope pulley as an alternative method of starting.

The petroil fuel is contained in a 1·6 pt tank made of rigid polythene and to permit the saw to be used in any position the fuel is drawn from the tank by a diaphragm pump integral with the carburettor. To avoid sediment being drawn out of the tank the fuel leaves the tank by a lockable tap and is drawn to this point by a flexible wobble pipe in the tank fitted with a weighted, felt packed brass end.

Chain lubrication is provided by a simple self-priming plunger pump drawing oil from a separate tank via a gauze filter mounted on the end of a rubber wobble pipe, and delivery is taken to a well formed by two spring steel side plates, through which the chain runs.

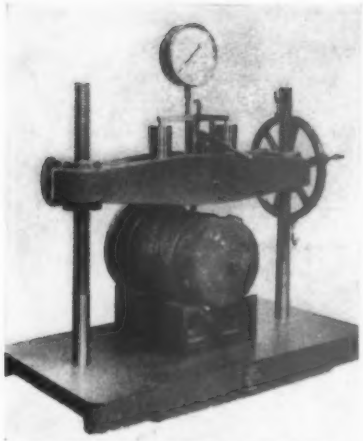
The DD8F Mk II uses a $\frac{7}{16}$ in. Oregon type chipper chain incorporating links made from Swedish steel and induction hardened rivets which permits a glass hard wearing surface and yet softened ends for easy riveting.

Controls on the DD 8F Mk II are grouped round the handle. It is therefore unnecessary for the operator to relax his concentration on the cut in order to locate a control, and the centrifugal clutch stops the chain as soon as control is lost.

CO_2 Shielded Arc Welding

A new process of CO_2 'bare wire' welding has been introduced by the Industrial Equipment Division, Philips Electrical Limited, Century House, Shaftesbury Avenue, London WC2, to speed up the mass-production of such welded parts as main chassis members, bottled gas cylinders, car wheels, etc. Furthermore, welds are protected from hydrogen and nitrogen by an atmosphere of CO_2 at a fraction of the price of argon.

Basically, the machine consists of a welding head which carries the wire at the appropriate feed rate and surrounds the arc with an atmosphere of CO_2. A single control lever engages the wire feed and switches on the carriage motor and arc. Water cooling is independent of main supplies. The welds performed are homogeneous and of deep and even penetration. The arc is self-regulating and stocks of expensive powders are not required. Nitrogen porosity is virtually eliminated by the low nitrogen and hydrogen content.



Brinell hardness tester with adjustable head

Hardness Testing Large Components

Specially designed for testing large components this Brinell hardness testing machine has recently been completed by Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester, 19.

The hand operated type Brinell head comprises an 8 in. dia 0–3000 kg pressure gauge, checkweights, hand operated pump and 10 mm dia ball support assembly have been fitted into a substantial crosshead.

The crosshead is supported on two screws which are located in the heavy cast iron base and is adjustable to any vertical position by a hand-wheel.

With a table 44 × 24 in. this particular machine has 30 in. clearance between the screws and is adjustable up to a maximum height of 24 in. between the base and the 10 mm dia steel ball. It is built under licence from the Tinius Olsen Testing Machine Company, Philadelphia, U.S.A.

Electro-mechanical Dial Indicating Comparator

A three-colour signal light indicator of "go", "no-go" (either + or −) combined with a dial indication of the amount of error outside the tolerance makes the Rubert-Hommel electro-mechanical comparator an invaluable aid in the inspection room. Fig. 1 shows the Hommel Microcontac electric dial gauge mounted on a comparator stand with cable connexion to the indicator box arranged for single dimension checking. The Microcontac dial gauge shown in Fig. 2 is a jewelled type high precision instrument accurate to ± 0·5% and can be supplied with 0·0001 in. or 0·0005 in. scale divisions. The tolerance for the electrical indication is adjusted by the two lateral screws, and according to this setting the indicator box will operate the green light for go, red light for + error and amber light for − error, and the amount of error can be read on the dial gauge. The same dial gauge can also be used for mechanical reading only and for this purpose two tolerance makers are provided. The plunger can be comfortably lifted with a flexible cable release, or by push-button.

For multiple gauging special fixtures for measuring up to 20 dimensions simultaneously and also angle connectors at 30, 45, 60 and 90° can be supplied by Rubert & Company Limited, Demmings Road, Cheadle, Cheshire.

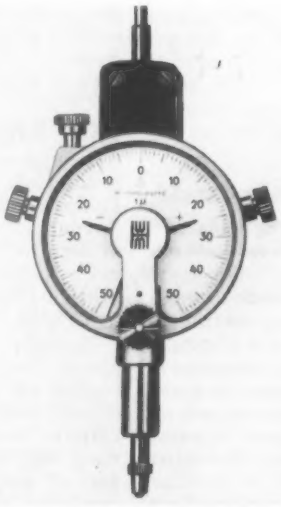
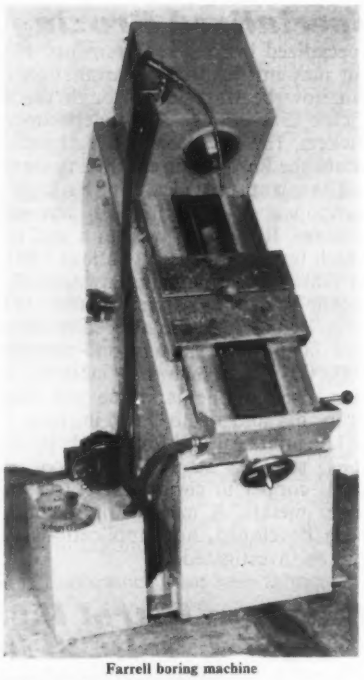


Fig. 1 (left).—Hommel Microcontac electric dial gauge mounted on a comparator stand and connected to the three-colour indicator. Fig. 2 (right).—Microcontac dial gauge with tolerance markers. Electrical tolerance indications are adjusted by the two lateral screws



Farrell boring machine

Single Point Boring Machine

The machine illustrated above which was originally developed by R. T. Farrell Machine Tools Limited, Station Buildings, Stamford New Road, Altrincham, for a special boring operation, has now become available for single point boring and drilling operations.

The angular slideways are mounted on a rigid fabricated cabinet which encloses the motors for the spindle and feed drives, the change gear mechanism and the switch gear. Mounted on the top of the slideways is a robust headstock which carries a large diameter spindle running in opposed taper roller bearings at the front and parallel roller bearings at the rear. The drive is from a 2 hp motor, by V-ropes, through change gears to a flywheel pulley on the spindle. The motor can be supplied as a single or two speed type, and, by means of change gears, provides a spindle range from 50 to 2500 rpm. The spindle nose is screwed and bored No. 5. Morse taper.

The work table which measures 16½ in × 12 in. is provided with a central spigot bore and a tenon to enable fixtures to be mounted. The drive to the table, from a 2 hp geared motor, through change gears to the feed screw, is split so as to provide variable forward feeds and a constant rapid return.

Kempe's Engineers Year Book. London, 1959; Morgan Brothers (Publishers) Limited. 82/6 (two volumes in case) (by post 85/-). 1324 × 1416 pp. $4\frac{3}{4} \times 6\frac{7}{8}$ in.

There is a motto on the spine of Kempe's Engineers Year Book, "Practice with Science", an apophthegm which indicates not only the material of the contents but also the way in which it is compiled. Within the two pairs of covers there must be essential information on every subject of practical use to all engineers and it is treated by experts for experts. This is true whether one looks up mathematics, machine tools or reinforced concrete, or any of the other eighty or so branches of engineering interest and practice covered by the text. In this year's edition there are three major revisions; "Flow Metering and Mechanical Testing", "Refrigeration", and "Paints and Varnishes", and many detail revisions throughout the text as a whole too numerous to mention here but among them we notice a particularly topical entry, the motion of missiles, satellites and escape velocity.

Mark's Mechanical Engineer's Handbook. Edited by Theodore Baumeister. New York, 1959; McGraw-Hill Book Company Inc. London; McGraw-Hill Publishing Company Limited. 151/- net (by post 153/3). 1858 + xix pp. 6 × 9 in.

This well known handbook was founded by Professor Marks in 1916 and edited by him through five editions up to 1951. The sixth edition now appears under a new editorship, and it reflects present trends in that it includes material on computing machines, nuclear power, instruments, controls, aerodynamics, and jet propulsion, these among 18 sections on both the theory and practice of mechanical engineering. The theoretical sections cover mathematics, mechanics and thermodynamics (e.g., stresses in framed structures, fluid flow, theory of models, heat transmission, vibration); there is ample coverage of materials (metals, concrete, paint, refractories, fuels); of power units (windmills, gas and steam turbines, boilers, I.C. engines, atomic reactors, hydro-electric plant); of the mechanical aspects of the different forms of transport; of handling machinery of all kinds; of structures; of heating and ventilating; of noise and ultrasonics; of welding; of pumping of metal and woodworking machines; of pumps; and there are sections on management subjects like costing, time and motion study, patents, and quality control. Altogether the book continues as a major compendium of mechanical engineering design and practice.

European Industry and Transport.—The stocking of coal was general throughout Europe last year, a result of falling demand, and steel production declined by 3% while capacity was increasing. The metal working industries generally have been adversely affected by a levelling off of investment activity in most Western European countries. The United Nations "Economic Bulletin for Europe" (H.M.S.O. 3/6 net) which gives details of these trends

books

and the figures relating to them, also refers at length to what has been happening in Eastern Europe and the Soviet Union where industrial expansion continues, rapidly in some countries. A significant feature of 1958 investment policy has been the rapid extension of railway electrification and gas pipelines—in the Soviet Union particularly investments in both are of unprecendented size.

The ninth "Annual Bulletin of Transport Statistics for Europe" (H.M.S.O. 5/- net) contains as usual many tables relating to traffic and equipment, but this year they are rearranged, there no longer being "main" and other tables, and tables and charts are now grouped together under the subject matter to which they refer. Appendices contain short studies on passenger road transport in Italy and goods road transport in France, and data on population and area of European countries.

Electrical Accidents.—The Report "Electrical Accidents and their Causes, 1957", published for the Ministry of Labour and National Service, by H.M. Stationery Office, price 5s., draws attention to the increasing use of protective multiple earthing, i.e., a method of protection in which the consumer's earth continuity conductor is connected to the system neutral conductor at or near the consumer's terminals. The report points out that unless the auxiliary earths are very effective there may be danger in such a system if the neutral conductor breaks. The application of electrical instrumentation to safety problems is also discussed and a number of applications are mentioned, such as the use of strain gauges to give warning of an excessive over-turning movement on cranes, and the employment of telecommunication techniques for enhancing safety in industry. Special precautions in instrumentation and control at nuclear energy power plants and factories are also mentioned. In analyzing the year's accidents the Report mentions that in spite of the continued rapid increase in the use of electricity for power, the number of accidents per year is now virtually steady and, if anything, falling.

"Overseas Directories".—Demand for the first issue of this publication, No. 1, EUROPE, was so great that the edition was soon out-of-print, but a revised edition, showing the Manchester Commercial Library's holdings of European directories, has now been published and copies can be obtained on application to the Commercial Librarian, Central Library, Manchester 2. (Tel. No. CENtral 7401. Telex 66-149.)

Machinery's Buyers' Guide. — The 30th edition of the annual buyers' guide published by *Machinery*, 21 West Street, Brighton 1, price 12/6 post free, is a volume of more than 1000 pages recording over 4500 suppliers of machine tools, small tools, metals and other material, and plant, all as used in the machine shop. There is a trade names index; and glossaries in French, Spanish, German and Russian, each with the English equivalents of the words.

The Engineer Buyers' Guide.—In addition to a guide to sources of supply for chemical plant, electrical equipment, engines and parts, machine tools and accessories, and sheet metal working machinery, the 1959 edition of the buyers' guide published by *The Engineer*, 28 Essex Street, Strand, London WC2, price 7/6 net (by post 9/3), gives particulars of forthcoming engineering and industrial exhibitions, engineering societies and institutions, and national undertakings. There is a separate alphabetical list of names and addresses of suppliers, a list of U.K. agents for foreign firms, and a trade names index.

Bibliography on Shell Moulding.—The U.S. Engineering Societies Library has published a selected list of over 200 annotated references to books,

reports and magazine articles published from 1952 to 1958, covering all aspects of shell moulding, including theory, principles, production practice in large and small ferrous and non-ferrous foundries, materials, design, testing methods, equipment, and costs. There are papers on the application of shell moulding to the manufacture of crankshafts and other automotive parts, waveguides, heaters, electric motor parts, gears, seal rings, valves, pipe flanges, bells, etc. This "ESL Bibliography No. 13" may be purchased from the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y., U.S.A., price $2.00.

B.S. 1815: Enamelled and cotton-covered copper conductors (oleo resinous enamel). Part 3: 1959. Round wire: Metric units. Price 4/6.

B.S. 1933: Varnish-bonded glass-covered copper conductors. Part 3: 1959. Round wire: Metric units. Price 4/6.

B.S. 2479: Enamelled and silk-covered or rayon-covered copper conductors (oleo-resinous enamel). Part 3: 1959. Round wire: Metric units. Price 5/-.

B.S. 2480: Silk-covered and rayon-covered copper conductors. Part 3: 1959. Round wire: Metric units. Price 5/-.

The requirements of all these standards are essentially the same as those of the corresponding standards in British units, but metric measure is used throughout and a complete range of standard metric sizes is given. For convenience, each of these new standards becomes Part 3 of the corresponding standard in British units. Consideration will be given to extending this system of numbering to B.S. 1961, B.S. 2039 and B.S. 2084 when they are next revised.

Steel boiler and superheated tubes (B.S. 3059:1958). Price 8/6.

This new publication containing 12 separate specifications, six being for carbon steel tubes and six for molybdenum steel tubes, of varying form and tensile strength, all material formerly dealt with in the following standards:

B.S. 494, B.S. 512, B.S. 1652, B.S. 1653, B.S. 1654, and B.S. 1678.

It contains requirements for hot finished seamless and cold drawn seamless carbon steel boiler and superheater tubes (27 ton/sq in. minimum tensile strength); and for hot finished seamless and cold drawn seamless 2¼% chromium, 1% molybdenum steel boiler and superheater tubes (27 or 31 ton/sq in. minimum tensile strength).

The present practice of designing on the basis of the temperature of the metal, as opposed to that of the steam is followed and temperature limitations on the use of electrically-welded tubes of "rimming" steel are no longer included.

The requirements for percentage elongations have been revised; they are related to an equivalent gauge length of four times the square root of the area of the test pieces, and modifications have been made to the requirements for the expanding test on tube ends.

New Standards

Screws and captive washers for aircraft. (B.S.G. 154). Price 4/-.

B.S.G. 154 specifies the material, dimensions, finish and part numbers for two sizes of B.A. screws. The screws, together with their washers, are used primarily in electrical connections, and although of slightly different dimensions, they are interchangeable with screws and washers complying with M.O.S. drawings AG5 1753 and 1754, which the standard is intended to replace.

Single-entry gland assemblies for aircraft electrical cables. (B.S.G. 155). Price 6/-.

B.S.G. 155 specifies the fittings to be used in the assembly of glands for use with aircraft electrical cables having a stabilized operating conductor temperature not greater than 90° C.

Requirements for the various components of these glands are specified in the following new publications.

B.S. No.	Title	Price
G 156	Glands for aircraft electrical cables.	3/-
G 157-166	Sealing sleeves and sealing cones for aircraft electrical and cable gland assemblies.	6/- (1 volume)
G 167-170	Bonding sleeves for aircraft electrical cable gland assemblies.	5/- (1 volume)
G 171	Washers for aircraft electrical cable gland assemblies	3/-
G 172	Union nuts for aircraft electrical cable gland assemblies.	3 -

Plugs and sockets for ground electrical supplies to aircraft. (B.S.G. 173). Price 7/6.

This standard specifies the performance requirements and mating dimensions for connections used for 28V d.c., 112V d.c. and 200V 400 cycle a.c. electrical supplies from a ground source to the aircraft. The plugs and socket dealt with comply with the requirements of a forthcoming ISO recommendation governing interchangeability features for such items.

Snap head aluminium and aluminium alloy rivets for aircraft. (B.S. SP77–SP80). **Snap head high nickel-copper alloy rivets for aircraft.** (B.S. SP81–SP82). **Mushroom head aluminium alloy rivets for aircraft.** (B.S. SP83–SP85) Price 4/- each standard.

These standards specify materials, dimensions, finish, marking and part numbers of the rivets. The rivet head forms are basically the same as those of rivets hitherto used by the aircraft industry, and the ranges embrace the same nominal sizes. In general, however, the dimensions of the rivets are more closely defined than previously.

Tyres for crane rail wheels (B.S. 3037: 1958). Price 4/-.

The publication is the first of what it is hoped will become a series on data for certain crane components (including further types of tyre). The size range of the double-flanged tyres extends from 18 in. dia × 4½ in. width to 36 in. dia × 9½ in. width. The clauses cover: dimensions, material, freedom from defects, Brinell hardness, re-tests, inspection, and testing facilities.

The publication concludes with an appendix which provides useful notes on manufacture.

Varnish-bonded glass-braided copper conductors (B.S. 3058:1958). Part 2: Rectangular conductors. Price 5/-.

This new British Standard is complementary to B.S. 1933: Part 2 which deals with rectangular copper conductors having glass-lapped coverings. B.S.3058 gives three classes of covering, each consisting of a single glass braid but differing in thickness. The requirements of the new standard are generally similar to those of B.S. 1933: Part 2 but the schedule of preferred sizes extends up to a sectional area of 0·1192 sq in.

British Standards Institution, 2 Park Street, London, W1.

BUSINESS & PROFESSIONAL

Personal

F. PERKINS LIMITED, Peterborough, announce several changes in its board following the take-over of the company by Massey-Ferguson (Holdings) Limited. **Mr. Frank Perkins,** who has resigned his office of joint managing director, remains chairman, and **Mr. M. I. Prichard, M.C.,** joint managing director, has been appointed managing director of the company. **Colonel W. E. Phillips,** chairman and chief executive officer of Massey-Ferguson Limited, Toronto, and **Mr. Albert A. Thornbrough,** president of Massey-Ferguson Limited, Toronto, become directors following the resignation of **Sir Richard Yeabsley, C.B.E.,** and **Mr. G. P. Ritchie.**

Mr. John L. Deffenbaugh was recently appointed manager of the new 650,000 sq ft tractor factory in Glasgow of Caterpillar Tractor Company Limited.

Major-General A. E. Walford, C.B., C.B.E., M.M., E.D., was recently elected chairman of the board of directors of Canadian Vickers Limited.

AFTER 43 years' service, **Mr. C. S. Youatt** has relinquished his position as deputy chairman of Rhodes, Brydon & Youatt Limited, but continues as a director. **Mr. A. H. Parkes,** deputy chairman and managing director of Small & Parkes Limited, has been appointed deputy chairman of Rhodes, Brydon & Youatt Limited, of which he is already a director. **Mr. R. L. Furnival** recently resigned from the board of Furnival & Co. Limited. **Mr. Harry Aston** has been elected to the board of Rhodes, Brydon & Youatt Limited as well as of Furnival & Co. Limited, and has now taken up his appointment as chief engineer for both companies.

THE Wakefield Castrol Group announce the appointment of **Mr. S. H. Oliver** as assistant manager of their group purchasing department.

GLOVER AND MAIN LIMITED announce that following the recent retirement of **Col. W. R. Glover, C.M.G., D.S.O., T.D.,** chairman of the group since 1949, **Mr. P. D. M. Aird, T.D.,** has been appointed chairman of Glover and Main Limited and the principal associated trading companies, Thomas Glover and Company Limited, R. & A. Main Limited and Main Water Heaters Limited.

METROPOLITAN-VICKERS ELECTRICAL Company Limited announces the appointment of **Mr. G. R. Higgs, B.Sc., M.I.E.E., M.I.Loco.E.,** as chief engineer, traction projects department; this appointment will enable **Mr. F. Whyman,** who relinquishes the position, to devote his full time to his duties as chief engineer, traction division. **Mr. J. Beasley, B.Sc.Hons., A.M.I.E.E., A.M.Inst.T.,** is appointed assistant chief engineer, traction control department; he succeeds **Mr. A. D. Ferguson,** who is appointed consulting engineer, traction control department. **Mr. J. L. Russell, Assoc.M.C.T., A.M.I.E.E.,** is appointed chief engineer, railway signals department; responsibility for this department is relinquished by **Mr. W. T. Gray,** chief engineer, traction control department. **Mr. J. F. Hancock** has been appointed assistant superintendent, maintenance department.

BRITISH INSULATED CALLENDER'S CABLES Limited announce that **Sir John Dean, B.Sc., A.R.I.C., F.I.R.I.,** has been appointed a director of the company. **Mr. C. S. F. Lane** has been appointed to the position of regional manager for Australia and New Zealand in the overseas organization in London. He succeeds **Mr. R. H. Semple,** who has taken up a senior executive post with an associate company in Australia.

THE NUCLEAR POWER PLANT COMPANY Limited, of Knutsford, Cheshire, announce that **Mr. R. Edwin McAlpine** has been elected chairman of the company in succession to the late **Sir Claude D. Gibb.**

SIR W. H. BAILEY & CO. LIMITED (Albion Works, Patricroft, Manchester) announce that **Mr. S. Watts,** former chief draughtsman, has been appointed chief engineer (contracts division) and that **Mr. B. Scott-Garrett** has joined the company as chief engineer (control division).

TECALEMIT LIMITED of Plymouth announce the following appointments. **Mr. T. Parrott** becomes service manager, responsible for the Service, Spares and Repairs Section at Great West Road, Brentford. **Mr. D. E. Ridgers** becomes assistant service manager. **Mr. J. G. H. Maxfield** is appointed industrial manager (Users); **Mr. B. C. Curran** becomes industrial manager (Manufacturers); **Mr. L. Halliwell** is appointed Northern regional sales manager, based at Wetherby, Yorkshire; **Mr. G. C. Abbott** is appointed assistant marketing manager; **Mr. G. Axworthy** becomes personal assistant to the general sales manager, **Mr. R. R. Parker. Mr. D. A. Monaghan** is appointed sales director of Foamite Limited. Foamite are fire protection engineers and a member of the Tacalemit Group.

Mr. W. L. Valenta has been appointed sales development engineer of Workington Iron and Steel Company, a branch of The United Steel Companies, Limited. Mr. Valenta, formerly production research engineer, is now responsible to the company's commercial manager.

Mr. P. G. Smyrk, hitherto manager of the export division of Johnson, Matthey & Co. Limited, and a director of several of its overseas subsidiaries, has now joined the board and has been appointed a joint managing director.

Mr. S. G. Gates, C.B.E., chairman, and **Mr. P. R. Scutt,** managing director of Tecalemit Limited, will join the board of British Filters Limited, Maidenhead, recently acquired by Tecalemit Limited. **Mr. T. E. Worth, B.A., M.I.Mech.E.,** present chairman and technical director, will continue in that capacity, together with **Mr. Nigel J. Bennett, D.F.C., A.C.A.,** who will continue as managing director.

THE Scottish Region of British Railways announces the following appointments: **Mr. H. Cheetham,** assistant stores superintendent, Eastern/North Eastern Regions, as supplies and contracts manager; **Mr. A. E. Bainbrigge,** assistant stores superintendent, Scottish Region, as supplies officer; **Mr. A. R. D. Roberts,** senior quantity surveyor, Chief Civil Engineer's Department, Scottish Region, as contracts officer.

Mr. George A. Williamson, M.I.Mech.E., who recently retired as director of engineering of Firestone Tyre & Rubber Company Limited, joined the company in February, 1928, as chief engineer. He was appointed director of engineering in 1953.

AERO CONTROLS LIMITED, Northampton, designers and manufacturers of a wide range of control and allied equipment for aircraft and general industry, announce the appointment of **Sqn. Ldr. W. F. G. Withers, M.B.E., R.A.F. (Retd.)** as general sales manager.

Mr. F. B. Strachan has succeeded **Mr. R. E. Wilson, M.I.Mech.E., M.I.P.E.,** as managing director of Fescol Limited. Mr. Wilson joined the company in 1928 and became managing director in 1941. Mr. Strachan has been assistant managing director since 1951. Under consequent staff changes, **Mr. W. A. Leslie** continues as director and sales manager; **Mr. F. Baden** is appointed works manager in London, and **Mr. C. W. Hay** succeeds him at Port Glasgow. **Mr. A. E. Lockley** is appointed works manager in Huddersfield, and **Mr. R. F. Burke** becomes works manager of the Midlands plant.

Mr. R. W. Stobbs, F.R.I.C., F.I.M., has been appointed general manager of Preformations Limited, Cheney Manor, Swin-

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'Eclipse' tool bit holders have been specially developed to get the very best from 'Eclipse' tool bits. They have a patent clamp, adjustable to variation of tool bit size which holds the tool absolutely rigid eliminating any tendency to "chatter."

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Ask the machine shop to check this

don, the company recently formed by The Plessey Company Limited. The directors are **Mr. A. G. Clark** (chairman), **Mr. A. E. Underwood**, and **Mr. Robert M. Arnold** (U.S.A.)

Mr. A. E. Gregg, Assoc.M.C.T., A.I.E.E., has been appointed general manager of F. & A. Parkinson Limited, Guiseley, one of the companies in the Crompton Parkinson Group. Mr. Gregg joined the company in 1936, and was formerly product manager for motors at Guiseley. The new product manager for Guiseley motors is **Mr. J. C. Mansfield, B.A.,** formerly assistant product manager. **Mr. G. H. Armstrong, A.M.I.Mech.E.,** has been appointed chief production engineer for the Southern Works of the Crompton Parkinson Group of Companies, and **Mr. G. Cubitt-Smith** succeeds him as production engineer at Crompton Parkinson (Chelmsford) Limited.

Mr. J. R. Hughes, A.M.I.E.E., M.Brit.I.R.E., has been appointed a director and commercial manager of Hivac Limited, a member of the Automatic Telephone & Electric Group.

Mr. H. G. Stage and **Mr. F. Tompkins** have been appointed directors of Nu-Swift Limited. Mr. Stage has been oversea marketing manager since 1952; Mr. Tompkins has been home sales manager since 1954.

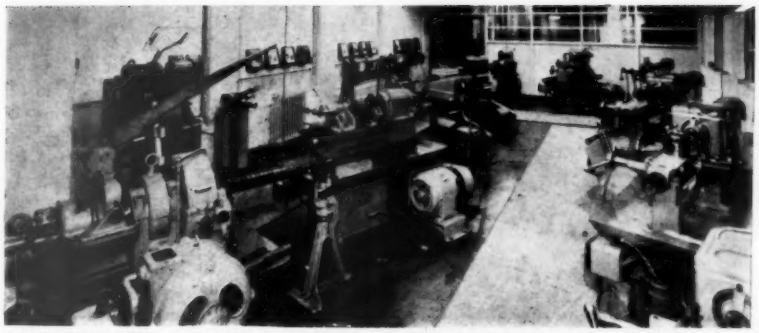
Mr. Harry J. Janssen has been appointed chief engineer of Hyster N.V., Nijmegen, The Netherlands.

The Earl of Halsbury has been invited by the directors of Lancashire Dynamo Holdings Limited to join the board of the company as vice-chairman.

Mr. T. Pooley, joint managing director, and **Mr. E. L. Townsend,** overseas director, of Expandite Limited, London, manufacturers of sealing compounds, etc., are now on a visit to Scandinavia where they will visit the company's distributors and manufacturing units.

ASSOCIATED BRITISH ENGINEERING LIMITED announce the following changes in group appointments. **Mr. David Bruce,** managing director of British Polar Engines, Glasgow, for 22 years, has now been appointed deputy chairman to the parent company, and is succeeded in British Polar by **Mr. J. M. Watson,** works director for the past four years. The new works director is **Mr. R. H. Arnold,** general manager of British Polar. The Group's deputy chairman, **Mr. O. R. Guard,** becomes vice-chairman.

After nearly 47 years service with the British Thomson-Houston Company Limited, Rugby, **Mr. C. H. Chaplain, A.I.E.E.,** manager of the publicity department, has retired. His successor is **Mr. H. G. Harlow, M.I.E.E.,** manager of BTH Newcastle office since May, 1955. Mr. Chaplain joined the BTH publicity department when it was first formed in 1913 and became manager in 1948. Mr. Harlow joined the company in 1920 and has served in several departments.



NEW SHOWROOM.—A representative range of machinery is on view in the new showroom opened recently by Messrs. Charles Taylor (Birmingham) Limited at Bartholomew Street, Birmingham 5. Demonstrations can be arranged at any time to suit visitors

Mr. John Clifford Duckworth, B.A., F.Inst.P., A.M.I.E.E., F.Inst.F., has now taken up his appointment as managing director of the National Research Development Corporation. **Mr. Dennis Hennessey** has been appointed by the Corporation to a new post of deputy managing director.

Obituary

WE regret to record the death of **Mr. J. Brook, A.M.I.P.E.,** works director of Dewhurst & Partner Limited. Mr. Brook, who was 60, was particularly interested in apprenticeship training schemes, and in the early 1920's inaugurated the Dewhurst scheme which has since been used as a model by other companies in the area.

WE regret to record the death of **Sir George Beharrell, D.S.O.,** former president of the Dunlop Rubber Company, at the age of 85. He joined Dunlop in 1922 and the following year was appointed managing director, becoming chairman in 1937. From 1949–57, he was the company's president.

WE regret to record the death of **Mr. J. L. S. Melville, M.B.E.,** South Western regional sales manager of Leyland Motors Limited. Mr. Melville, who was 61, joined the company in 1913.

WE regret to record the death of **Dr. J. B. Mavor, M.I.Mech.E., M.I.E.E.,** chairman until his retirement in 1956 of Mavor and Coulson Limited of Glasgow. Born in 1889, he joined the company in 1910 in the contracts department, the side on which his father had founded the business nearly 30 years before. Dr. Mavor became managing director in 1934 and chairman in 1946.

Addresses

LAURENCE, SCOTT & ELECTROMOTORS Limited, Gothic Works, Norwich, have now installed Telex. The Telex number is 1723, Answer-back code "Gothic Norwich".

LANG PNEUMATIC LIMITED have combined their offices and works at Wolverhampton and as from March 2 their address is Owen Road, Wolverhampton. Telephone Nos. Wolverhampton 25221-2-3.

HILGER AND WATTS LIMITED, members of the Scientific Instrument Manufacturers Association of Great Britain, have formed an affiliated U.S.A. company, Hilger & Watts Inc., in association with Engis Equipment Company of Chicago. The company has also opened a branch office in Western Germany at Witten, near Dortmund.

A. A. JONES & SHIPMAN LIMITED have opened a new London showroom and office at 50/52 Great Peter Street, SW1, providing demonstration facilities and after-sales service.

PHILPLUG LIMITED have now moved to the offices of Expandite Limited at Chase Road, London NW10.

K.G.S. BEARING COMPANY LIMITED, Wolverhampton, has recently changed its title to F.A.G. Bearing Company Limited. The company is the U.K. sales division for F.A.G. ball, cylindrical, taper and spherical roller bearings.

INTERNATIONAL COMPUTERS AND TABULATORS Limited (I.C.T.), 17 Park Lane, London W1, is the name by which the newly-merged British Tabulating Machine Company Limited and Powers-Samas Accounting Machines Limited is now known.

A PRIVATE company, Perkins Outboard Marine Limited, has been formed by F. Perkins Limited, the Peterborough diesel engine manufacturers, to market the company's new petrol outboard motors.

C. W. F. HAMILTON & CO. LIMITED, of Middleton, Christchurch, New Zealand, manufacturers of agricultural and earth-moving machinery, are to produce up to 2,000,000 feet of Dexion a year.

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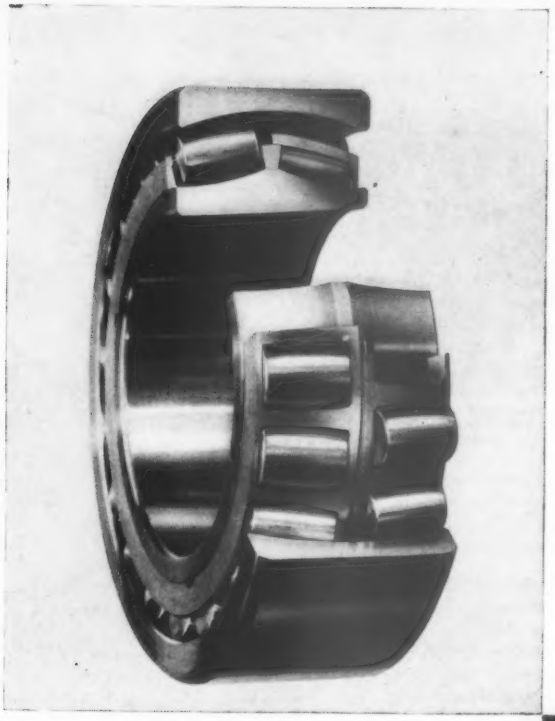
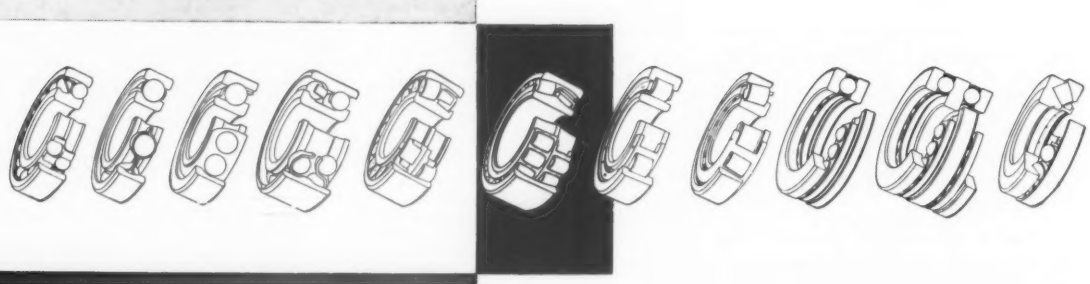


Only SKF *can offer such a wide selection of British-made bearings*



Since its introduction by SKF in 1920, the spherical roller bearing has come to be regarded as the pre-eminent type of bearing for carrying heavy loads. In addition, it is completely self-aligning — a feature which is only present to a limited extent, if at all, in other types of roller bearing.

This means that the *whole* load carrying capacity of SKF spherical roller bearings is available for carrying the load; none is wasted on local stress concentrations due to unavoidable inaccuracies in machining, or deflection under load of housings or shafts.

SKF has recently introduced an improved design of spherical roller bearing designated the C-type with a carrying capacity approximately 40% greater than bearings of the original design. Weight for weight and size for size SKF spherical roller bearings are the strongest in the world. That is why you will find them in applications where loads are heavy and bearing space restricted.

The spherical roller bearing in its various forms is one of the four basic bearing types, ball, cylindrical roller, taper roller and spherical roller manufactured in Great Britain by The Skefko Ball Bearing Company Ltd.

THE SKEFKO BALL BEARING COMPANY LIMITED · LUTON · BEDS

THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES: BALL CYLINDRICAL ROLLER, TAPER ROLLER AND SPHERICAL ROLLER

G176

A NEW holding company, Weir-Catton Limited, has been formed by G. & J. Weir Holdings Limited and Catton & Co. Limited on the completion of the merger of Catton & Co. Limited and Weir Foundries Limited.

THE name of the Radio and Telecommunication Section of The Institution of Electrical Engineers has been changed to Electronics and Communications Section.

R. F. FRASER-SMITH, 69 Kings Cross Road, London WC1, telephone Terminus 1064/5, is a new organization set up principally for the manufacture and supply of industrial radiographic equipment and accessories for non-destructive inspection.

DOUGHTY SCHOFIELD FRAN SUTTON & Associates, Crossway House, Bracknell, Berks, has been formed to advise on industrial design and to handle promotional activities, including marketing and publicity.

SIMMONDS AEROCESSORIES LIMITED, a member of the Firth Cleveland Group, announce the formation in Belgium of Simmonds Aerocessories (Belgium) S.A. as a subsidiary company, with offices at 25 Rue Faider, Brussels. The manager is Mr. George Harms.

HIGH DUTY ALLOYS LIMITED have opened a new Midland area sales office at Queen's College Chambers, 38a Paradise Street, Birmingham 1, telephone Midland 3286, to handle sales of hiduminium sheet, extrusions, tube and castings. All home market enquiries and quotations in regard to forgings will be handled from a new sales department at the forging division of the company, Windsor Road, Redditch, telephone Redditch 711. Mr. G. F. Ingram has been appointed sales manager and Mr. F. Clark sales office manager.

THE YALE AND TOWNE MANUFACTURING Company has recently opened a new service depot in Scotland on the modern Nerston Industrial Estate at East Kilbride. The full address of the depot is: The Yale and Towne Service Depot, Wilson Place, Nerston Industrial Estate, East Kilbride, Lanarkshire. Telephone number, East Kilbride 20241.

THE MORGAN CRUCIBLE COMPANY LIMITED have moved their sales office to larger premises at Wandsworth Works, Point Pleasant, Wandsworth, London SW18, where a new factory and laboratory for the production of Sinterlink has been established.

METAL INDUSTRIES LIMITED has formed a new company, Brookhirst Igranic (Europe) Limited, with headquarters in Brussels (62 rue Joseph II), to co-ordinate the European activities of its electrical subsidiary, Brookhirst Igranic Limited.

Contracts and Work in Progress

HEENAN & FROUDE LIMITED, Worcester.—Order placed by Techno-impex of Budapest, Hungary, for four large dynamometers, size RFA 6.

MORTON MACHINE COMPANY LIMITED, Wishaw, Scotland.—Order from Techmashimport, Moscow, for more than £70,000-worth of plastics mixing machines.

FARRAR BOILERWORKS LIMITED, Newark, Notts (member of the E.V. Industrials Group).—Polish order for continuous fish meal and oil plants valued at £85,000. The plants will be installed on the type B15 Polish factory trawlers being built at Gdansk, Poland. Work has already commenced and the first plant was scheduled for delivery by the end of March.

SAVAGE & PARSONS LIMITED, Watford, Herts.—Order for a pair of master slave manipulators for the remote handling of radioactive materials received from Negretti & Zambra (South Africa) Limited, for display at the Rand Easter Show to be held in Johannesburg this month. Other export orders just received include pairs of manipulators for the French Commissariat de L'Energie D'Atomique, and for the Belgian Centre D'Etude de L'Energie Nucleaire at Mol-Donk.

CREED & CO. LIMITED, Telegraph House, Croydon.—Delivery made of 60 of their new Model Seventy-five teleprinters for the Royal Netherlands Navy.

NIFE BATTERIES LIMITED, Redditch.—Large orders for battery equipment for the £100 M. steelworks being constructed at Durgapur in the Damodar Valley, West Bengal.

KELVIN HUGHES (INDUSTRIAL) LIMITED.—Order from KOVO, the Czech buying organization, through Exico of Sloane Street, London SW, for automatic ultrasonic inspection equipment valued at £10,000.

TAYLOR WOODROW (OVERSEAS) LIMITED.—Share in railway contract worth nearly £9¼ M. in French Equatorial Africa.

LEYLAND MOTORS LIMITED.—Contracts to the value of nearly £110,000 placed by the Ulster Transport Authority for the supply of 68 goods vehicle chassis.

Share with Scammel Lorries Limited of Watford, contract for the supply of 25 Leyland Comet-Scammel tractor chassis.

Supply of 43 lightweight Claymore chassis to U.T.A. by Albion Motors Limited. Also contract worth over £110,000 for 24 Caledonia chassis for Bulwark Transport Limited, Chippenham.

£5 M. contract for locally manufactured goods for South African Railways secured by associate company, Union Carriage and Wagon Co. (Pty.) Limited.

CROMPTON PARKINSON LIMITED.—Electrical equipment for sub-stations, part of a further order valued at over £1 M. for Rustyfa Limited, the British consortium company founded in 1957 for the purpose of supplying plant and equipment for a large tyre factory now being built in the Ukraine.

THE BRITISH THOMSON-HOUSTON COMPANY Limited.—Traction control equipment for new rolling stock for London Transport Underground. The total value of work in hand at BTH for train equipments for London Transport is approximately £3 M.

METROPOLITAN-VICKERS ELECTRICAL Company Limited.—Order value approximately £250,000 for a 40 million electron-volt linear accelerator for Deutsches Elektronen-Synchrotron (D.E.S.Y.), Research Group, Hamburg.

VICKERS-ARMSTRONGS LIMITED.—Order from Ministry of Supply for 60 Vickers Vigor tractors for Army use.

FERRANTI LIMITED, Hollinwood.—High-speed Mercury electronic digital computor, valued at about £150,000, for the University of Buenos Aires, Argentina.

SIEMENS EDISON SWAN LIMITED.—Contract for multi-channel carrier equipment for Ghana Posts and Telegraphs Department.

BRITISH TRANSPORT COMMISSION have placed contracts worth £16¼ M. for main-line diesel-electric locomotives from English Electric Company Limited, British Thomson-Houston Company Limited, and Crompton Parkinson Limited.

DAVID BROWN INDUSTRIES LIMITED. Automobile Gearbox Division.—Current orders for gearboxes for heavy duty vehicles are almost double those in hand a year ago and the same applies to gearboxes for light duty vehicles. Orders for gearboxes for medium capacity vehicles are four times as numerous as last year at this time.

New Welding Course

IN addition to courses for welding operators and engineers, Quasi-Arc Limited have now arranged a special course of two weeks' duration for foremen, supervisors and inspectors, to be held in the company's welding school at Bilston from July 20–31, 1959. Applications for enrolment should be sent to Quasi-Arc Limited, Bilston, Staffs.

David Brown Pensioners

PENSIONERS of David Brown Industries Limited were entertained by the company at the annual luncheon held in January. Altogether 79 attended, an increase of 22 over the previous year, with an average age of 72 and an average service of 33 years.

Film News

Driving Force, Mile after Mile, Controlling Link.—These three films are available from Crompton Parkinson Limited (Crompton House, Aldwych, London WC2), for showing on 16 mm sound equipment. All three are in Eastman colour with commentaries and show manufacturing sequences

LIFT WITHOUT SLIP

with Goodyear rough top conveyor belting

GOODYEAR CONVEYOR BELTING
TYPE D. ROUGH TOP
A. Thick top cover with deeply impressed gripping pattern.
B. Carcass of 28 or 32 oz. high quality cotton duck.
C. Thickness of hard wearing bottom cover or friction surface to suit service.

A DEEP REGULAR pattern, exclusive to Goodyear, enables this belting to take a firm grip on sacks and on smooth articles, such as cartons. The pattern, plus a choice between soft and hard top cover to suit the needs of the installation, ensures freedom from slip on slopes up to 30° inclination.

Goodyear Rough Top belting, like all styles of conveyor belting in the Goodyear range, is solely designed for a specific type of duty, and to give long, reliable service at lowest cost per ton carried.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING • TRANSMISSION BELTING • HOSE • V-BELTS

from five of the Crompton Parkinson U.K. factories. *Driving Force* is a detailed visit to the Doncaster, Guiseley and Chelmsford motor works. *Mile after Mile* is a cable film, running time 10 min, and *Controlling Link* is all about switchgear.

New Atomic Information Centre

THE purpose of the new information centre at the London office of the United Kingdom Atomic Energy Authority is to provide a convenient centre in London where members of the public, commercial firms and other organizations may consult published unclassified material and seek advice on sources of information on U.K. atomic energy matters. Next to the centre is a Photographic Library with a collection of some 8000 photographs. The address of the U.K.A.E.A. London office is 11 Charles II Street, SW1. The centre is open from Mon. to Fri. inclusive, between 9.30 a.m. and 5 p.m.

Reactor School

COURSES for senior technical executives in industry are held periodically at the Harwell Reactor School. The next course on which places are available will be held from June 15–25, 1959. The fee for the course is 50 guineas exclusive of accommodation and those who are interested should apply for application forms and details from: The Principal, Reactor School, Atomic Energy Research Establishment, Harwell, Didcot, Berks. A second course on the Control and Instrumentation of Reactors will be held from July 7–17, 1959, inclusive, and will be open to British and overseas students.

Long Service Presentations

GOLD badges for the first 10 years' service, bearing an emerald for every additional decade of service, were recently presented to over 100 members of the staff of Charles Churchill & Co. Limited, Birmingham, by the chairman. Mr. J. B. S. Gabriel, with the exception of the first badge of all. This was presented by another director of the company, Mr. H. E. Churchill (a grandson of the original founder of Charles Churchill & Co. Limited) to the member with the longest service, namely, Mr. J. B. S. Gabriel, the chairman. Mr. Gabriel is a son of the Gabriel who first joined Charles Churchill in the 1890's, and he himself joined the company in September, 1913.

Agents and Distributors

A. A. JONES & SHIPMAN LIMITED, Leicester, by agreement with Diagrit Limited, manufacturers of diamond tools, Tonbridge, Kent, are now able to offer a comprehensive service on diamond honing, and are now the sole selling agents throughout the world for these diamond hones, which will be marketed under the registered trade mark "Diamold".

MARTONAIR LIMITED, manufacturers of pneumatic equipment, have appointed agents in Switzerland—Notz and Co. A.G., Murtenstrasse 65, Biel-Bienne 1, Switzerland (telephone 032-2-55-22). Notz and Co. A.G. also have offices in Zurich.

HADFIELDS LIMITED home sales representatives are to act on behalf of Hadfields group of companies as a whole including Millspaugh Limited and their subsidiaries. This arrangement does not include Millspaugh pulp and paper making machinery or the plant for paper making works erected by Millspaugh-Wimpey.

IN addition to having extensive rights on the Conreur coal dryer and briquetting equipment, Neldco Processes Limited, Crossway House, Bracknell, Berks. markets the products of Sala Maskinfabriks AB, manufacturers of mining machinery in Sweden. It is also engaged in the design of a new type of coal cleaning plant and the development of an entirely new type of filter.

Siemens Edison Swan Reorganize

As part of the long term reorganization of the A.E.I. Group, Siemens Edison Swan Limited are to divide into three divisions: cables, telecommunications and radio and electronic components. Controlling these divisions are Mr. J. S. A. Bunting, Mr. W. G. Patterson and Mr. J. W. Ridgeway who will hold appointments on the board of A.E.I. Divisional Management Company Limited. The cables and telecommunications divisions began operation on January 1. The radio and electronics division will come into operation on January 1, 1960.

E.C.G.D. Cover for Engineering Goods

THE Export Credits Guarantee Department has simplified arrangements for cover on those engineering goods commonly sold on credit terms ranging from six months to three years maximum, whatever the unit value of those goods, which are covered by "Extended Terms" endorsements or memoranda attached to the normal short-term cover. There will be no objection to credit terms up to two years maximum in respect of orders of £20,000 or more for either commercial credit users (such as distributors) or for end-user buyers; and up to three years maximum for orders of £50,000 or more for end-user buyers.

Long Service Awards

SEVEN more employees of G. & J. Weir Limited, engineers of Cathcart, recently received long service awards on the completion of 50 years' service with the company. This brings the total to 67, 12 of whom are still actively engaged with the company.

Winston Electronics Agency Appointments

"THE whole of Europe is waiting for British goods" was stated by Mr. F. Winston Reynolds, chairman and managing director of Winston Electronics Limited, Shepperton, Middlesex, recently back from a several weeks' 3,000-mile sales tour of Holland, Germany, Austria, Italy and France. For several years, Mr. Reynolds has been stepping up his European exports by these annual visits, and he has now appointed head agents in Holland, Western Germany, Austria and Italy.

E.M.I.—Cossor Canadian Agreement

A POLICY of co-operation in the development of the Canadian market in the field of electronic engineering is announced by the recent E.M.I.-Cossor Canadian agreement. Further capital will be subscribed by Electric & Musical Industries Limited to Cossor (Canada) Limited, and the name of the latter will be changed to E.M.I.-Cossor Electronics Limited.

Founders Company Awards

THE Founders Company Medal, cast in bronze, has been awarded to each of four liverymen of the company to mark their services "to the Art and Mystery of Founding and to the Company". The recipients are Dr. James George Pearce, C.B.E. and Dr. James Edgar Hurst, C.B.E., J.P. and to Messieurs Christopher Chamley Booth, J.P. and John Joseph Sheehan, B.Sc.

Machine Tool Demonstration

DEMONSTRATIONS have been arranged by Rockwell Machine Tool Company Limited at their London and Birmingham showrooms to introduce a new range of milling machines by F. Werner of Berlin. Fingertip controls and electric clutches are two features of these machines. The London showroom demonstrations were held from March 9–20. At the Birmingham showrooms the demonstrations will be from April 7–17 inclusive; hours 9–5.30 except on Tuesday, 14th (9–7) and Saturday, 11th (9–1).

RAWLBOLTS LIFT 5-TON BOULDERS

When wire slinging fails, how do you excavate round granite boulders, weighing five tons or more each, from a pit 12 ft. square and 20 ft. deep? That was the problem in Hong Kong. It was solved by drilling the granite to take a " K " size Rawlbolt fitted with a 1" diameter eyebolt. Says Mr. A. C. Howarth, M.I.C. Project Manager—" This device proved invaluable and lifted boulders up to five tons in weight, even though there was considerable extra load due to suction when we were getting down to the sandbed."

It is this tremendous *grip* of Rawlbolts that ensures safety in any bolt-fixing job, large or small.

We are indebted to Messrs. George Wimpey & Co. Ltd., the Building and Civil Engineering Contractors, for the above information. The photograph was kindly provided by Mr. Howarth from the North Point Generating Station, Hong Kong.

"Ask on your trade card or letter paper for free copy of Rawlplug TECHNICAL DATA SHEET folder R1519 which has been specially designed for gentlemen of the Drawing Board. An invaluable source of reference for dimensions, loads, weights, etc., of Rawlplug Fixing Devices."

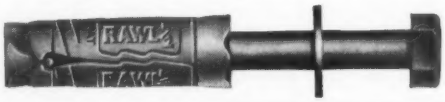
Fixed in minutes

Rawlbolts grip by *expansion*. You drill the material, insert the Rawlbolt, tighten up. The job is ready to take its full load *at once*—no grouting in, no waiting for cement to harden. A Rawlbolt fixing is made in only a fraction of the time taken by any other method.

Write now for free technical literature, and file it for quick reference when your next bolt-fixing job turns up.

SIZES & TYPES FOR EVERY PURPOSE

For bolting down machines and heavy plant, use the Loose Bolt Rawlbolt—inserted after the machine is slid into position; for wall-fixings, the Bolt Projecting Rawlbolt. There are Rawlbolts for supporting pipework and for use with pipe hangers, and Hook and Eye Rawlbolts too. Bolt diameters from ¼" upwards.



RAWLBOLTS

For Speed and Strength!

THE RAWLPLUG CO. LTD. RAWLPLUG **CROMWELL RD., LONDON, S.W.7**

B.581

Hydraulic Variable Gears and Controllers

Folder GP/8, a new addition to the current range of technical publications on Carter hydraulic infinitely variable speed gears is intended as a guide to the entire range of both A and F type gears and includes dimension and rating tables.

Leaflet DFC/2, a new publication giving details and dimensions of the hydraulic relay speed control for F type gears provides notes on the application of this particular control for variable speed drives in cases where only light operating forces are available.

Details of auxiliary equipment (reduction gears, etc.) for use with the gears are given in separate publications. Copies of all the publications are freely available on application to Carter Gears Limited, Thornbury Road, Bradford 3, Yorks.

Spraying Refractory Linings

To reduce the cost of furnace refractory relining or repairing The Morgan Crucible Company, Battersea Church Road, London, SW11, have developed a Tri-Mor refractory material which can be applied with a cement gun. The material, Tri-Mor Dense Guncrete, will withstand temperatures up to 1300° C., is quite plastic when mixed with water and has a very low rebound loss when "gunned". In service its behaviour is very similar to that of a normal refractory concrete.

Further details are contained in a leaflet RD85.

Electron Microscope Wall Chart

A glossy coloured wall chart illustrating the Metropolitan-Vickers Type EM6 electron microscope has been produced primarily for the use of technical colleges and institutions. Supplies have been reserved for lecturers and science teachers, and are available on request to the company's publicity department, at Trafford Park, Manchester, 17.

Automatic Arc Welding

A brochure which describes fully the Autopak automatic arc welding equipment has been published by Rockweld Limited, Commerce Way, Croydon, Surrey. Contents include descriptions of submerged arc welding, electrical connections, welding head, associated equipment, and welding data.

Chains for Transmission and Handling

A card folder summarizing the Renold range of chains, wheels and accessories for every field of industry has been issued by Renold Chains Limited, Manchester, with a pre-paid card for obtaining catalogues.

Cold Rolled Steel Strip

An illustrated brochure has been issued by Firth Cleveland Steel Strip Limited, Tipton, Staffs, a member of the Firth Cleveland Group, to describe the range of cold rolled steel strip and flattened wire recently introduced by them under the trade mark Fircleve.

The brochure contains much useful information on the properties and applications of various grades of strip, including clearly drawn graphic hardness comparison and equivalent tensile strength tables.

Welding Shop Mechanization

Elevating weld platforms, rotating manipulators and revolving welding columns and booms are freely illustrated in three brochures issued by Yates Plant Limited, Whidborne Street, London WC1, who are members of the Baker Perkins Group.

Bolt, Nut and Screw Directory

The 1959 edition of Heads and Threads Buyers' Guide is now available from The British Bolt, Nut, Screw and Rivet Federation, the joint secretaries being

Trade Literature

Heathcote & Coleman, 69 Harborne Road, Edgbaston, Birmingham 15, and Peat, Marwick, Mitchell & Company, Queens Square, Middlesbrough. A directory of its members and their addresses is set out in tabular form and indicates the range of products made by each one. A list of relevant British Standards is given for all classes of fastenings.

Motor Controllers and Voltage Regulators

Variac motor speed controllers, type HP-033 and HPD-033 providing variable speeds from zero to full in either direction for a ½ hp motor are shown a leaflet from Claude Lyons Limited, Valley Works, Hoddesdon, Herts. Other new products include stabilized d.c. power suppliers, type PS-300-A, variable power supplier, type PV-250-A and automatic voltage regulator type TCVR-7000-S31 and are shown in leaflets bearing the respective type numbers.

Gas Analysers—General Principles

A 16-page publication issued by Cambridge Instruments Company Limited, 13 Grosvenor Place, London SW1, deals with some of the technical problems associated with gas analysis by the thermal conductivity method. It gives performance data on the Cambridge Katharometer and includes notes on the types of measurement available and on the possible sources of error.

Centre-Line Indicator-Controller for Gas Composition and Temperature Control

An instrument incorporating a novel display of the "desired" and "measured values", is described in a leaflet issued by Cambridge Instrument Company Limited, 13, Grosvenor Place, London, SW1. When the pointer lines up with a fixed datum on the centre line of the scale, the plant is "on control", and any change in this condition is immediately visible, even from distances at which scale graduation cannot be read.

Instrument Makers' Precision Drilling Machine

The spindle of the Ime drilling machine is designed for using drills of 4·7 mm down to the smallest drill made 0·04 mm (0·0016 in.) using 8 mm split collets.

The bearing approximately two-thirds the length of the spindle is in one piece to obviate any misalignment. A compound slide rest is available for mounting on the machine table. Full details are given in a leaflet issued by the Ideal Machine Tool Engineering Company Limited, 282 Kingsland Road, London, E8.

Steam Turbines, 750KW—100MW Ratings

Two publications on steam turbines have been issued by divisions of The English Electric Company Limited, Stafford. The first ST/117, is a 40-page publication describing non-reheat steam turbines of 10 MW ratings and above. Many sectional arrangement drawings are reproduced of complete turbines and components. Details of manufacture are illustrated together with installations varying from 10 MW to 100 MW units. It is issued by their Steam Turbine Division, at Rugby. The second, ST/121, issued by their Small Steam Turbine Department, Whetstone, Nr. Leicester, is a 12-page publication describing geared steam turbo-generating sets of the condenser type, with outputs from 750 kW to 5000 kW. These are intended for industrial power stations and marine applications.

New Factories

Ashington. Newcastle Hospital Board. The tender of Dodds and Son, Dark Lane, Morpeth at £13,055 has been accepted for the construction of a boilerhouse at Ashington General Hospital.

Blyth. Central Electricity Generating Board. A contract for the steel frame for a new turbine house and boilerhouse at Blyth "B" power station, has been awarded to The Cleveland Bridge and Engineering Company Limited, Darlington.

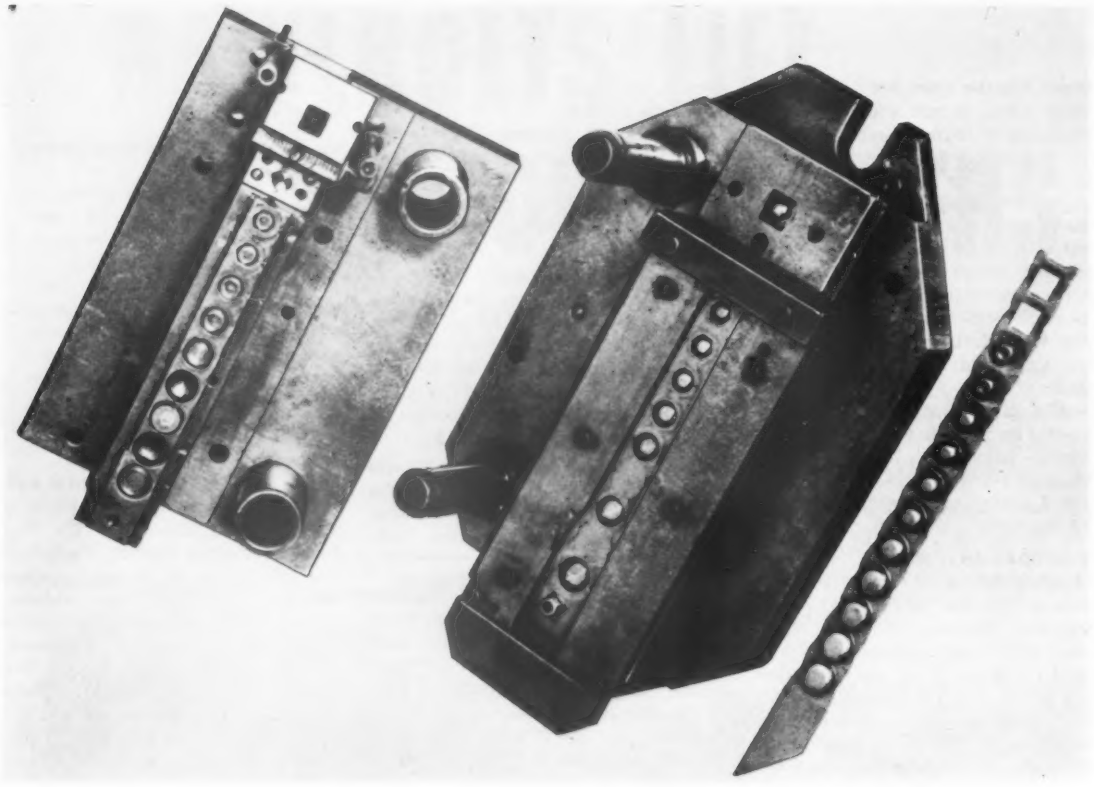
Boldon (Co. Durham). Bitulac Limited are to erect a warehouse of 10,000 sq ft and the contract has been let to Gordon Durham and Company, East Boldon.

Gateshead. Renold Chains Limited, Scotswood Road, Newcastle upon Tyne. The architects for proposed distribution depot and offices at Team Valley trading estate are Arthur & Kirkup, 13 Swinburne Street, Gateshead.

Hartlepool. Price Tailors Limited. A contract is expected to be let soon for proposed factory additions (25,000 sq ft). Tenders are being considered by North-Eastern Trading Estates, Limited, Gateshead. The architects are Newrick & Blackbell, 58 John Street, Sunderland.

Hebburn (Co. Durham). Thubron Timber Company Limited. The architect for rebuilding the mill is H. Gatoff, 51 Grainger Street, Newcastle upon Tyne.

Continued on page 192



Savings on the horizon

You'll save money times over if you choose Edgar Allen Double Six Die Steel for intricate or hard-working dies. This high-carbon, high chromium super die steel is recommended where there are long runs, or where the section is intricate, because it will minimise warping or distortion. Dies made from it have punched over two million bi-metal electric contacts from 0·156″ × 0·0086″ phosphor-bronze-silver, but if you don't want electrical contacts, you might want annealed spring steel clips; Double Six has stamped over four million of these from ½″ × 0·018″ material. Write for details of this, and other Edgar Allen Die Steels, using the request form.

EDGAR ALLEN

DOUBLE SIX
DIE STEEL

To Edgar Allen & Co. Ltd., Sheffield, 9.
Please post "Die Steels" folder to:
Name .....
Firm .....
Address .....
..... M.W.

EDGAR ALLEN & CO. LIMITED
IMPERIAL STEEL WORKS · SHEFFIELD·9

TELEPHONE: SHEFFIELD 41054 TELEGRAMS: ALLEN, SHEFFIELD 9

Continued from page 191

Jarrow-on-Tyne. The Mercantile Dry Dock Company Limited have been offered a Government loan of £750,000 towards the construction of a new dry dock about 600 ft long. It is understood that tenders for the work have been received. The consulting engineers are R. T. James & Partners, Clavering Place, Newcastle upon Tyne.

Middlesbrough. Tees Valley and Cleveland Water Board, Corporation Road, Middlesbrough, are to erect a £76,000 works depot at Cargo Fleet Lane. The tender of Fleming Brothers, Glasgow, has been accepted for steelwork, while other work to the value of £33,700 is to be done by direct labour. The Board's chief engineer is T. S. R. Winter.

The Town Council is to build new central depot costing about £140,000. Tenders are to be considered for erecting workshops (£91,000), and offices (£34,000), in connection with the scheme. The Borough Engineer is J. A. Kenyon.

Newcastle upon Tyne. Pasmill (Paper Products), Limited, Lime Street, Newcastle upon Tyne are considering extending their factory to provide work for another 50 people.

Carricks (Caterers), Limited, Ponteland Road. Extensions are proposed to the despatch depot. The architect is C. A. Cornish, 25 Wigmore Place, London, W1.

Winthrop Laboratories, Edgefield Road. Extension plans are being prepared by Cackett, Burns Dick and MacKellar, 21 Ellison Place, Newcastle.

North Shields. Dryers Limited, joinery manufacturers, Dock Road, are to erect a box factory.

Peterlee. Peterlee Development Corporation are planning the erection of another factory. The Corporation's chief architect is W. H. Scott.

South Shields. The N.C.B., Station Road, are to erect new workshops at Westoe Colliery, and have prepared their own plans.

Sunderland. G. Clark and North-Eastern Marine, Limited. Plans have been approved for extending the main office block at Southwick Engine Works. The contractors are Brims and Co. Limited, City Road, Newcastle upon Tyne.

Workington. The Workington Iron and Steel Company. Work has started on the erection of a new ore and sinter plant. The main contractors are Head Wrightson and Co. Limited, Thornaby-on-Tees, while the civil engineering contractors are John Laing and Sons, Dalston Road, Carlisle.

Ashton-under-Lyne. H. Broadbent & Son Limited, Park Street. Plans approved for extensions to the works and the erection of a new iron foundry in Cavendish Street.

Bath. C. & J. Clark Limited, Street, Somerset, are to erect a new factory at Rush Hill.

Birmingham. A. & H. Edwards, machine tool manufacturers, 40 Great Hampton Street, are to erect a new factory in Hatchett Street.

Bolton. Thynne Engineers Limited, 13-35 Thynne Street. Extensions are to be made to the works in Matthew Street North.

J. Nabb & Company propose to make extensions to their works in Lowndes Street.

Bootle. Solicitor Law Stationery Society Limited, 19 North John Street. A new factory and offices are to be erected in Wakefield Road.

Bournemouth. Access Equipment Limited, Maylands Avenue, Boxmoor. The architects for extensions are James & Bywater, 5 Bloomsbury Street, London, WC1.

Bridgnorth. Rexin Precast (Midlands) Limited, Knowle Sands. A new factory and offices are to be built in Old Worcester Road.

Bristol. Arthur Scull & Son Limited, Prince Buildings, are to make extensions to their works.

Burnley. Lenclo Sheet Metal Company, Sycamore Avenue. Works extensions.

Chatham. W. & J. Mackay and Co. Limited, Fair Row. The architects for extensions are G. E. Clay & Partners, 10 New Road, Rochester.

Cheltenham. Spirex-Sarco Limited, Tennyson Road. Extensions are to be made to the works.

Colwyn Bay. J. K. Smit & Sons Limited, industrial diamond tool manufacturers. Plans have been approved for the erection of a new factory.

Croydon. Godfrey Phillips Limited, 112 Commercial Street, London, E1, are to make extensions to their Jablo Works, Mill Lane.

Dagenham. The Coborn Engineering Company Limited, 45 New North Road, Ilford, are to erect a new factory at Freshwater Road.

Dunstable. Hawthorn Baker Limited, Nicholas Lane are to erect a new factory near the town centre.

New Factories

Eccles. St. Michael Engineering Company. A new factory is to be built north of Weymouth Road.

Enfield. Sangamo Weston Limited. Extensions are to be made to the works in Great Cambridge Road.

Scripto Pens Limited are to make extensions to their factory in Lockfield Avenue.

Exeter. Marcus Hodges & Sons Limited, Water Lane, have received permission for the erection of new workshops and offices at Willey's Avenue.

Frimley. S. C. Johnson & Son Limited, West Drayton. New factory.

Glasgow. Matthew White and Co. Limited, have applied for permission to make extensions to their cereal mills at Washington Street.

Renold Engineering Company Limited, Mathieson Lane. New workshops are to be erected at Rosebery Street.

Leeds. Catton and Co. Limited, steel founders, 29 Chadwick Street, are considering the development of a site off Pontefract Lane.

Letchworth. British Tabulating Machine Company Limited, Icknield Way, propose the erection of a new factory.

London. F. Austin (Leyton) Limited, Argall Avenue, Leyton, London, E10. Factory extension.

G. Delgado Limited, 55 East Road, London, N1, are to extend their factory. The architect is G. K. Parker, 26 Lowfield Street, Dartford.

Luton. Ronald Lyon (Estates) Limited, Lyon House, Lyon Road, Horsham, Surrey, are to erect four new factories at Cradock Road.

Manchester. G. H. Scholes and Co. Limited, Wylex Works, Wythenshawe. Extensions are to be made to the factory in Sharston Road, Northenden.

David Moseley & Sons Limited. Plans have been approved for extensions to the factory at Ardwick.

The Co-operative Wholesale Society Limited, Balloon Street, are to extend their butter-blending factory at Ten Acres Lane, Newton Heath.

Newbury. A Woolacott & Rappings Limited have applied for permission to erect new buildings in London Road.

Northampton. Wilson & Tilt Limited, Spring Lane. Factory to be extended.

Reading. Gillette Industries Limited, Basingstoke Road. Works extensions.

Redditch. Lewis Spring Company Limited, Resilient Works, Queen Street, have submitted amended plans for a new factory at Studley Road.

Rotherham. Norton Grinding Wheel Company Limited. Extensions are to be made to the works at Old Sheffield Road.

Smethwick. Flexible Drives (Gilman) Limited. Extensions to the works in High Street.

Watford. Keens (Watford) Limited, Marlborough Road, are seeking a site on Holywell Industrial Estate for a new factory.

West Bromwich. Steel Parts Limited. Extensions are to be made to the works in Brickhouse Lane. The architects are Simms & Gifford, 323 High Street.

P. H. Muntz & Barwell Limited, Great Bridge Street. Architects for extensions to the tube mills are Harry Bloomer & Son, 73 Hagley Road, Edgbaston.

Fraserburgh. Mac Fisheries Limited. Aberdeenshire Planning Committee has given permission for the erection of a new fish processing department at Park Street, Fraserburgh, and engine room extension. Some additional eighty to ninety people will be employed.

Glasgow. Thomas Potter Limited, Arcadia Street, Bridgeton, engineers' furnishers and tool merchants. Modernizing their 100 year old premises at Arcadia Street.

Cockburns (Springs) Limited, a new subsidiary of Cockburns Limited, valve makers. New 20,000 sq ft of space has been equipped with £40,000 of plant to make and process springs for industry.

Irvine, Ayrshire. Scottish-Scandinavian Machine Tool Company Limited have taken 9000 sq ft of space in the former Ordnance factory now being developed at an industrial estate; they will make Swedish design machine tools.

Lerwick, Stornoway and Mallaig. The Herring Industry Board is to install new deep freezing plants. At Lerwick the factory will be expanded by two-thirds. The Stornoway factory will be expanded by one-third this year and by one-third again next year. The Mallaig project is a complete quick freezing plant. A new major cold store will also be built at Stornoway.

Peterhead. Crosse and Blackwell Limited are to build a large deep freezing plant at their Peterhead white fish and herring factory.

Bedford. Texas Instruments Limited. An extensive new plant is planned for erection on a site of 240,000 sq ft at Hoo Farm, Bedford. Building will commence early in the New Year and by 1963 it is expected that 1400 people will be working for the company.

Birmingham. Triplex Safety Glass Company Limited expect their new warehouse at King's Norton to be ready shortly. This will add 12,000 sq ft to their capacity.

Llandudno Junction. A.E.I.-Hotpoint Limited are doubling their productive capacity and will provide work for about 500 more people.

Peterborough. A.E.I.-Hotpoint Limited are having major extensions to their refrigerator factory, and will provide work for additional 300 people.

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